3 February 2003

Rawlins RMP/EIS
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To: Field Supervisor, Rawlins Field Office, Bureau of Land Management.
From: Stephen J. Dinsmore, Department of Wildlife and Fisheries, Mississippi State University, Box 9690, Mississippi State, MS 39762.
Subject: Rawlins RMP scoping comments for the Mountain Plover.

This memo provides detailed comments that I hope will aid decisions regarding Mountain Plover management in the revised Great Divide Resource Management Plan (RMP). I have studied breeding Mountain Plovers in Montana since 1991, have surveyed for Mountain Plovers across much of their present breeding range, and have published and continue to publish the results of my on-going plover research in the peer-reviewed literature.

The Mountain Plover is a local and declining bird of the western Great Plains and is currently under review for Threatened status under the U. S. Endangered Species Act (U. S. Department of the Interior 1999). It is one of the rarest North American birds with an estimated population of 8,000 to 10,000 individuals (Knopf 1996). Their conservation hinges on the protection of remaining breeding habitat, including prairie dog colonies, and through the use of proactive plover management that protects nesting sites and uses tools such as fire and rotational grazing to enhance other nesting areas.

Mountain Plovers breed primarily in Montana, Wyoming, and Colorado and sparingly in surrounding states as well as Texas and Mexico (Knopf 1996). Mountain Plovers are uncommon breeders in southern Wyoming (Dorn and Dorn 1999), although there have been no formal surveys in Wyoming to estimate spatial variation in abundance. The Great Divide Resource Area includes at least 2 well known plover breeding areas: the Laramie Plains area in Albany County and the Mexican Flats area in Carbon County. Both areas support at least moderate numbers of breeding plovers, and current research is focusing on estimating plover numbers in these and other areas of Wyoming. Relative to other breeding areas, less is known about Mountain Plovers breeding in Wyoming. Thus, the following comments are based on a review of published literature on Mountain Plovers with an emphasis on studies conducted in Wyoming.

Specific points for your consideration in the revised Great Divide RMP include:

1. Annual surveys. There is a clear need for conducting annual surveys for nesting Mountain Plovers throughout the Great Divide Resource Management Area. Surveys are needed to estimate abundance of plovers within this region, and will provide data necessary to assess future fluctuations in plover numbers. Surveys should be designed to understand distribution and abundance during the nesting and brood-rearing seasons, and could secondarily address issues such as habitat use, differences between nesting and brood-rearing habitat, and other topics of interest. Future impacts to plovers resulting from actions in the Great Divide Resource Management Area cannot be fully measured without a thorough understanding of plover distribution *and* abundance.
2. Landscape requirements for maintaining Mountain Plovers. The specific requirements for maintaining viable numbers of Mountain Plovers within the Great Divide Resource Management Area are unknown, although they include several important criteria. The Mountain Plover is a disturbed-prairie or semi-desert species (Knopf and Miller 1994) and is characterized as a breeding bird of high plains and desert tablelands (Graul 1975, Knopf 1996). They prefer disturbed habitats for nesting, including areas occupied by prairie dogs (*Cynomys* spp.; Knowles et al. 1982, Samson and Knopf 1994, Knopf 1996). Mountain

Plovers selectively nest on active prairie dog colonies, especially those of black-tailed prairie dogs (Knowles et al. 1982, Olsen-Edge and Edge 1987, Dinsmore 2001), but also occasionally those of the white-tailed prairie dog (*C. leucurus*) (Ellison-Manning and White 2001a). In many parts of Wyoming, including the Great Divide Resource Management Area, plovers nest in semi-desert habitats on high tablelands, generally in areas dominated by *Atriplex* spp. and *Artemisia* spp. (Parrish et al. 1993, Knopf 1996). All sites used by nesting plovers range-wide include short vegetation (typically <5 cm; Graul 1975, Olsen and Edge 1985, Parrish et al. 1993, Ellison-Manning and White 2001b), a bare-ground component (typically >30%; Knopf and Miller 1994), some history of disturbance (e.g., grazing or fire; Day 1994, Olsen and Edge 1985, Knopf 1996, Ellison-Manning and White 2001a), and flat or gently sloping landscapes (Graul 1975). Minimum-area requirements for plover broods have been estimated at 28 ha (Knopf and Rupert 1996), but similar requirements for adult plovers are unknown. Given this information, management for plovers within the Great Divide Resource Management Area should emphasize their preferred habitats (using the above criteria). The number of Mountain Plovers necessary to maintain a viable population within the Great Divide Resource Management Area is unknown, and it is likely that this is not even a discrete population of plovers. I recommend that these landscape-level questions (e.g., minimum viable population size) be the focus of future research.

3. Population trends. There have been no formal surveys to estimate trends in Mountain Plover numbers within the Great Divide Resource Management Area, either from Wyoming Game and Fish Department files or from the published literature. At a larger spatial scale, Breeding Bird Survey (BBS) data for all of Wyoming indicate a non-significant negative trend (-2.37, $P = 0.51$) for the period 1966 to 2000 (Sauer et al. 2001). However, BBS data are subject to many sources of bias and should be interpreted with caution (see Link and Sauer 1998). Thus, there is weak evidence for a long-term negative trend in plover numbers in Wyoming, but trends at more localized scales are unknown.

4. Habitat quality trends in the Great Divide Resource Management Area. There have been no detailed surveys of Mountain Plover habitat within this region, and specific factors that contribute to quality nesting habitat for this species are unknown (but see #2 above for general characteristics of nesting sites). I recommend you conduct a designated survey for plover nesting habitat, using the criteria listed in #2 above, to provide valuable future baseline data.
5. Relationship between habitat quality and predation. The revised Great Divide RMP should continue to emphasize providing plover nesting habitat that meets the criteria listed in #2 above. The specific relationship between habitat quality and susceptibility to predation (nests, chicks, and/or adults) is unknown for the Mountain Plover. Plovers nesting in native habitats such as prairie dog colonies in Montana experienced high nesting success for a ground-nesting bird; nesting success varied temporally within the nesting season and was negatively impacted by rain events, but neither of these relates to habitat quality (Dinsmore 2001). No other nesting studies, nor any brood or age-specific survival study, have examined the relationship between habitat and susceptibility to predation. The potential impacts of human development projects such as drill pads and additional roads on plovers are many, and could potentially alter the predator regime such that plovers are negatively impacted. Such development could enhance habitat for several potential plover predators (several birds of prey, Black-billed Magpie and other corvids, and several species of mammals), thus negatively impacting plovers. If the revised Great Divide RMP includes provisions for providing less than optimal plover nesting habitat, then managers may indirectly promote plover exposure to additional predators that favor these human-disturbed areas.
6. Existing Bureau of Land Management documents (e.g., existing Great Divide RMP and the Seminoe Road Coalbed Methane EA) specifically address possible impacts and subsequent mitigation measures for Mountain Plovers. After a careful review of these documents (especially U. S. Department of Interior 2001, Appendix E), I recommend the following for consideration in the revised Great Divide RMP:

a. Annual surveys should be conducted during the period 15 April to 15 June; the earlier start date is needed to better detect plovers before they begin nesting.

b. Activity delay times of 37 days (active nest) and 7 days (brood) seem adequate given this species nesting cycle and the precocial nature of the chicks.

c. Important plover nesting areas should receive full protection from development activities. I am concerned that existing documents permit plover nesting and/or brood areas to be impacted/destroyed, without a provision promoting their long-term persistence. Some quality nesting/brood-rearing sites may not be used every year, and in years when they are not used they can be legally and negatively impacted without regard to their overall importance to nesting plovers. The emphasis on plover use areas, defined on an annual basis, is simply too weak to favor the long-term persistence of plovers in this area. I recommend that you define 2 levels of plover use: 1) areas of plover concentration, which I define as sites used by plovers ≥3 years in a 5-year period, or sites with ≥5 pairs of plovers in any given year, and 2) sites that are used infrequently, which includes sites that are occupied by plovers <3 years out of any 5-year period, and those sites with <5 pairs in any year. The former sites should receive full protection, perhaps in the form of an Area of Critical Environmental Concern (ACEC) designation, while the latter sites could be developed, with no surface occupancy (NSO) restrictions, if absolutely necessary. I recommend a no surface occupancy buffer zone of a minimum of 0.25 miles around such sites.

d. I strongly recommend that, whenever possible, you seek to avoid surface disturbance during mining operations. No surface occupancy drilling is an alternative to surface disturbance, and would ameliorate some of the negative effects of drilling operations on Mountain Plovers.

e. Areas with white-tailed prairie dogs should be withdrawn from surface development and should only be developed under no surface occupancy drilling. I recommend the same no surface occupancy buffer zone (a minimum of 0.25 miles) around these areas. Areas with prairie dogs represent a high quality habitat for nesting plovers (Olsen and Edge 1985, Dinsmore 2001) and should receive special protection. I also recommend you consider enhancing prairie dog numbers within this region, specifically to provide high quality plover nesting habitat.

f. Future construction/site preparation should include measures to minimize or avoid building structures (fence posts, phone poles, etc.) that can serve as avian predator perches.

7. Long-term effects assessment. Predicting the possible long-term effects of Great Divide RMP management actions to Mountain Plovers poses many challenges. Any such assessment will require detailed information on annual surveys and yearly estimates of nesting and fledging success. Using these yearly estimates, long-term patterns exhibited by plovers can be formally assessed using trend analyses on, for example, the number of breeding plovers. Such analyses will only be meaningful over a "long" time period, preferably >5 years. At this time, I see no strong need for a formal meta-analysis because baseline data are simply not available for key life history components of Mountain Plovers such as brood survival and geographic variation in age-specific annual survival. I do, however, support such an analysis at present if it is used in an exploratory fashion to suggest areas where information is lacking or where future efforts should be expended. When detailed baseline information eventually becomes available, a formal meta-analysis on annual survival and/or annual reproductive success would be useful. Modeling exercises to assess the possible impacts of extreme weather events on local plover numbers are not recommended at this time because baseline data necessary for such models are not yet available.

8. Mitigation. Plover nesting areas will continue to require some protection from disturbance during the nesting season, and in no way do I endorse mineral development in plover concentration areas within the Great Divide Resource Management Area. Plovers frequently nest near areas of human disturbance, including roadways, drill pads, and other forms of human disturbance (Knopf

1996, Ellison-Manning and White 2001a), although their success in these areas relative to other native habitats has not been evaluated. In areas of plover concentration (see definition in #6c), I recommend that there be no development; these sites should be off-limits to ensure that quality nesting areas receive long-term protection. At other sites (e.g., those used infrequently by plovers; see definition in #6c), the following mitigation measures should be followed. Plover nesting areas should be protected by a 100m buffer during the nesting season (10 April to 10 July), a 0.25 mi construction buffer should be placed on all nesting sites, the 200m active nest buffer, specific restrictions on construction of possible avian predator perches, and road and driving restrictions, as outlined in the Decision of Record (U. S. Department of the Interior 2001). Mitigation should also specifically include provisions for enhancing other nesting habitats used by Mountain Plovers, including prairie dog colonies.

After reviewing all available information on Mountain Plovers that is pertinent to the Great Divide RMP, I offer the following 3 recommendations for future monitoring and information needs:

a. Any monitoring of Mountain Plovers should be conducted using accepted survey methodology. Survey design considerations should include the random selection of areas to be surveyed, surveys that minimize roadside bias (e.g., do not conduct only road-based surveys), incorporation of distance sampling theory to estimate plover densities and trends (Buckland et al. 2001), and conducting surveys during the pre-nesting period (mid-April to mid-June) when plovers are most visible. Surveys should also stress obtaining adequate sample sizes for analyses, although the small number of plovers may limit this goal.
b. Adaptive resource management. This strategy should be incorporated into the management of plovers in the Great Divide Resource Management Area as follows. First, reliable estimates of plover numbers in this area are needed. Second, based upon these estimates and the results of nest and brood monitoring, managers will have the flexibility to adjust their activities to meet changes in the

status of plovers in this area. Third, managers will need to specifically monitor plover response to management activities so that management can be "adaptive".

c. In my opinion, critical information needs include a rigorous estimate of the number of Mountain Plovers nesting in the Great Divide Resource Management Area, an understanding of how productivity varies between disturbed and undisturbed sites, and how human activities specifically impact plover nesting success and chick survival in areas of mineral development.

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COMMENTARY ON BIOLOGICAL (*MICROPHYTIC*) SOIL CRUSTS IN THE RAWLINS RESOURCE MANAGEMENT AREA

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Introduction: The Scoping comments on biological soil crusts submitted below review their biological attributes, ecological roles and distribution within the boundaries of the Great Divide Basin and other lands of the BLM Rawlins Resource Management Area. Comments have been directed to the existing and potential adverse impacts of human related activities within the management area and their potential long-term consequences. The report concludes with management recommendations for assessment, mitigation, and monitoring.

Definition of Biological Soil Crusts.

Communities of microorganisms, predominantly cyanobacteria (blue green algae), green algae, filamentous fungi, lichens, and non-vascular plants (mosses), inhabit the surface soil layer in arid and semiarid landscapes throughout the world. These biological soil crusts (**BSC**), also known as cryptogamic, microbiotic, or microphytic crusts, consist of water-stable aggregations of soil particles, primarily silt and clay, held together by the vegetative bodies and adhesive properties of the colonizing organisms (**1**). Limited annual precipitation facilitates BSC development. Therefore BSC communities are found worldwide either within areas inhospitable to vascular plant growth or where plants are slow to establish and are marginally productive having sparse canopies and widely spaced individuals.

In the initial stage of development BSC are *smooth* in contour, often appearing as fragile, wafer-thin aggregations of surface soil particles. They are formed by the binding action of bluegreen algae, green algae and fungi. Soil erosion at the margins of crust colonies results in other crust forms (morphologies): *rough*, with markedly roughened surfaces; *rolling*, where they become evenly mounded; and *pinnacled*, pedicelate mounds that can be up to 15 cm high (**1, 5**). A predictable succession of algae and fungi, then lichens and finally mosses inhabit the crusts as they mature and become stabilized. Crust thickness and biological composition can often be used as indication of BSC age. Apart from human related disturbances, the rate at which crusts develop is strongly influenced by climatic factors and soil conditions. Whereas soil factors greatly influence vegetation structure and composition, the vegetation likewise influences the type and extent of crust development. As measured by observations of recovery following disturbance the time required for BSC to reach maturity ranges widely from 2 years in cool deserts to over 300 years in extreme deserts (**2**).

Ecological benefits: role in maintaining vegetation, watershed integrity and soils.

By virtue of numerous scientific studies, BSC are regarded as important components of healthy arid and semiarid landscapes because they perform an essential role in maintaining

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vegetation, soil, and watershed integrity (**3,10**). Healthy landscapes have been defined as those with little or no evidence of active erosion, and the ability to support a diverse BSC and vascular plant cover. Perhaps the greatest asset of BSC to the fragile habitats in which they occur is the reduction of the erosive effects of wind and water (**4, 7**). It should be noted however that soil stabilization is not realized in dune areas where the sand content exceeds 80% and the soils are not frost-heaved (**16**). Human caused desertification processes have dramatically increased dune landscapes to the detriment of BSC communities on a worldwide scale (**1**).

Because semi-arid soils, like those of the Rawlins RMA, are generally nitrogen limited, BSC can be important sources of nitrogen for vascular plant growth. Crust-dwelling blue-green algae are capable of binding atmospheric nitrogen in a form available to and quickly utilized by plants and plant seedlings (**12**). Plant growth and establishment is also benefited in stable soil crust areas by their facilitation of flow and retention of water in the underlying soil (**3**). Crustal organisms contribute as much as 2 kilograms of organic matter per hectare which retains water against gravitational loss and also binds significant amounts of mineral nutrients needed for vascular plant growth. BSC enhance seed entrapment and provide favorable sites for the establishment of plant seedlings. The provision of suitable growth conditions for plants indirectly contributes to the long-term stability and production of animal forage in arid and semiarid landscapes (**1**). Another, but less studied benefit is the role of BSC as a natural barrier to the establishment of weedy annual species, like Cheat grass (**11**).

Distribution and habitats of soil-crust communities

The greatest development of biological crusts in Western North America is associated with the semiarid shrublands of the Great Basin. These soil crusts, heavily dominated by lichens and mosses, occur extensively over the entire region. They have been found to cover 80% or more of the soil surface in the absence of vascular plants (**9**). In both shrublands and woodlands, soil crusts occupy the interspaces between plants or beneath sparse canopies where sunlight, essential for crust growth, is available. Pinnacled crusts are more common in sagebrush steppe dominated by sagebrush species, and in coniferous woodlands with juniper and pine species. Rough crusts are typical of semi-desert shrublands with greasewood and shadscale/saltbush species as principal shrubs. Smooth crusts are typical of the mostly barren playas and the initial stages of crust succession in dunes (**1**).

Analysis of Wyoming soil crusts, distribution, condition, and trends

To date, assessment and monitoring of biological soil crusts in Wyoming has been largely neglected by both the scientific community and land resource managers. A recent survey of soil crusts in Wyoming showed them to be similar in morphology to those found in the sagebrush steppes of Utah, but not in composition. Well-developed crust cover was documented only in areas free from local grazing disturbances. Comparison of the prevalent crust species by presence and commonness in undisturbed and disturbed sites revealed both quantitative and qualitative decrease in diversity and abundance in the disturbed site (**13, 14**).

I conducted a cursory survey of biological soil crusts within the Great Divide Resource Area (GDRA), and verified the widespread presence of biological soil crusts. Crust composition

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and cover was inventoried in numerous sites in the following areas: a 50 mile transect through the Great Divide basin parallel to WY Highway 789; a 36 mile transect through BLM checkerboard lands parallel to Interstate 80; a 34 mile transect along US Highway 287 between Lamont and Rawlins; and various transect segments in the Ferris, Laramie, Seminoe, and Shirley mountains, Shirley basin, and the upper north Platte River valley (States 2002. See APPENDIX for survey documentation).

As is typical of all grasslands bordering the eastern slopes of the Rocky Mountain front ranges, crust presence and cover in the eastern half of the GDRA (in Converse, Albany, Laramie and parts of Natrona counties) was sparse and often absent in areas of high cover vegetation. The greatest density and diversity was confined mostly to exposed ridges and escarpments. . Bryophyte crusts were the most common indicating historical stability but limited tolerance to recent disturbances. Extensive soil crust destruction was observed in disturbed sites, highlighting the need for assessment disturbance factors.

In the western half of GDRA (Carbon, Sweetwater, Fremont and parts of Natrona counties) shrublands and woodland vegetation replace grasslands. Wyoming big sagebrush is the most abundant shrub and occurs in a vast mosaic intermixed with other species of sagebrush, greasewood, shadscale and juniper. Although soil crusts are widely distributed throughout these rangelands, they are only locally abundant and are often discontinuous as small fragmented patches harbored beneath shrub canopies. Crusts were also fairly abundant in a few management exclosures that had not been breached by livestock in recent years. Again a preponderance of bryophyte crusts was indicative of past crust stability and maturity but their current condition reflects a long history of disturbance continuing up to the present. On the basis of BSC survey results from analogous sagebrush steppe and desert shrubland areas in Idaho and Utah (9), the relative abundance and diversity of soil crusts were found to be considerably lower than expected. Of the 60 sites selected for soil crust inventory, few were free from disturbance impacts (see *Appendix* for photographic illustrations of crust disturbance).

Disturbance factors and soil crust recovery potential.

Likely causes for soil crust disturbance observed in the GDRA survey:

- Trampling by domestic livestock and ungulate wildlife species (e.g. antelope, wild horses)
- Mineral Resource Industry activities (seismic exploration, oil & gas development, coalbed methane development)
- Recreation activities (ORV/vehicle trampling, hiker trampling)
- Invasive weeds and agricultural crops (decades of encroachment)
- Rodents and other soil dwelling/digging animals (minimal area affected)
- Fire (appears to be particularly damaging in shrub communities; less in grasslands)
- Climatological events (e.g. Extreme drought, soil erosion and burial of crusts esp. in dunes)
- Chemical spills and other biogeochemical changes (potential impacts by airborne pollutants)

The highly degraded condition of soil crusts in the GDRA is indicative of the dire need for additional investigation, mapping and assessment. Human activities, particularly land-use by the mineral resource industry, livestock grazing and agriculture with associated introduction of crop and invasive plants, and recreation have been and will undoubtedly be major contributors to (1) decrease in BSC density/abundance, (2) alteration of crust species composition and (3) diminution of their ecological role. Collectively, this will have a direct effect on the stability, biodiversity, and biogeochemistry of the landscapes where they are found **(4, 2)**. Recovery from long-term disturbance has been documented, but it may require protection for many years, depending on climate, soil type, and severity of disturbance **(2)**. Additionally, timing and intensity of disturbance impacts will, to a large degree, dictate the success of restoration efforts.

Management of biological soil crusts.

There is good evidence that BSC will recover if given the opportunity **(2)**. Recommendations and guidelines for the management of landscapes containing BSC have been documented in a recent BLM publication **(18)**. Of great significance is the fact that many of the same factors that threaten crust survival and ecosystem functioning are also common to the shrubs, particularly sagebrush, in shared habitats. . For the most part management strategies developed for shrublands, including assessment, monitoring, and mitigation protocols, are also applicable to biological soil crusts. BLM studies in sagebrush steppe in Idaho indicate a strong correlation between the Biological Soil Crust Stability Index (BSCSI) and the health of sagebrush steppe **(10)**. Unfortunately there has been only minimal testing of this model but its further refinement and application is urgently needed (see recommendations). The urgent need for improved management of Wyoming's 50,000 square miles of sagebrush was succinctly expressed in a editorial by Tom Reed in *Wyoming Wildlife,* the official publication of the Wyoming Game and Fish Commission: "Many sagebrush stands are imperiled. Drought, oil and gas development; overgrazing by livestock, feral horses, and wildlife; conversion of sagebrush grasslands to monocultures of grass and weeds; and ORV use are all having significant impacts on the State's sagebrush communities." **(17)**.

Sagebrush steppe, a dominant feature of the Wyoming landscape for thousands of years, has been shown to be sensitive to disturbance by animal and vehicular trampling, the effects of which are still visible on the landscape from decades past. Historic trampling by grazing animals may be responsible for the observed decline in the associated biological crusts today **(8)**. Careful study is needed in this area since some range managers refute the scientific evidence given for the beneficial role of soil crusts **(19)**. They assert with counterarguments that intensive cattle grazing and associated trampling serves to destroy crusts which have been retarding the advance of the whole community for thousands of years. However, this is not likely to be the case since the ecological benefits of BSC and the detrimental impacts of livestock trampling to those benefits has been documented and validated in many scientifically reliable laboratory and field studies around the world **(7)**.

Need for GDRA management objectives to address the deterioration in quality of rangelands containing biological soil crusts.

In a careful review of the GDRA RMP **(15)** no evidence was found to indicate the recognition of, or concern for, the extent and degree to which activities of the mineral extraction industry might have on BSC and associated soils and vegetation. Although concerns and management recommendations are available in BLM publications **(18)**, there were no

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management objectives or mitigation guidelines pertaining to soil crust disturbance set forth in either the RMP or any recent POD (e.g. Cow Creek, Blue Sky, Sun Dog) issued for the GDRA. To the contrary, general management objectives of the GRDA- RMP (15) focus on providing habitat quality for wildlife species in specially designated high priority habitats at the expense of the vegetative condition and ecological quality in habitats of lower priority. The rationale given for this approach is simply stated as follows: "because lower priority habitats have less wildlife and vegetative diversity, they can be subjected to the disturbances of multiple, conflicting uses more readily without sustaining significant adverse impacts to wildlife." This may well be the case for immediate or short-term responses to most land-use impacts. However, considering the present condition of habitats in moderate and low priority categories, cumulative long-term effects have led to potentially serious degradation of soil and vegetation resources throughout the GDRA. All habitat types containing biological crusts are presently classified as either moderate priority (sagebrush steppe, and woodlands) or low priority (saltbush steppe, greasewood, badlands, and sand dunes). Given the current state of degradation, it appears that resource managers have not been able to achieve the stated general management objectives for these habitats under the existing management guidelines (15).

Identification of assessment, mitigation and monitoring needs for BSC habitat improvement and management to be included as requirements in the RMP revision.

Assessment of the cumulative long-term effects of extractive industry impacts on BSC should be prescribed in the RMP revision. Long term monitoring is required to assess rangeland health relative to the ecological roles fulfilled by BSC communities. Monitoring has been used to assess impacts of specific land uses, to measure recovery, and to determine "normal" background variation and "functional potential" of BSC in the absence of disturbance (11). BSC, particularly the lichen component, have been successfully used to monitor biodiversity and ecosystem function and health in grasslands and sagebrush steppes similar to those found in the GDRA (10). Monitoring with morphological crust groups has been shown to be an effective approach in measuring both biological crust condition and that of associated vegetation (3). Soil crusts can be evaluated using standard or slightly modified rangeland assessment techniques, including line-intercept, line-point, and quadrat based methods (11).

Conduct detailed surveys and mapping of critical resource areas. Remote sensing technologies used to map soil crust distribution have been developed but additional research is needed to refine the methodology (6). Both ground based and aerial photography was useful in this paper to identify areas of disturbance attributable to gas and coalbed methane seismic exploration (See Appendix). Ground validation of aerial photography will be necessary for accurate analysis of the visual impacts.

Analyses of the environmental impacts on biological soil crusts should be required of all development projects including but not limited to right-of-ways, coal, oil, gas and seismic exploration permits, and permits to drill and test.

BSC should be used to monitor biodiversity and ecosystem function and health in grasslands and sagebrush steppes of the GDRA The potential for the BSCSI to serve as an area-

wide management indicator should be explored with the objective of establishing response benchmarks on which to base mitigation actions

Recommended mitigation actions (based on literature sources and personal observation)

1. Establish management objectives and mitigation guidelines to reduce the cumulative effects and disturbance footprints of energy development on BSC:

- require lighter impact alternatives to seismic exploration and eliminate thumper-trucks in the fragile BSC areas.
- close and restore the unused energy exploration corridors to pre-disturbance conditions and limit grazing disturbance to wildlife use until recovery is achieved.
- reduce the amount of land that will be trampled, scraped and impacted with roads and drill pads (i.e. employ directional drilling technology)

2. Develop and implement long-term monitoring protocols for the restoration of soil crust communities

- adapt/refine monitoring protocols, in particular the Biological Soil Crust Stability Index, for evaluation of existing BSC condition. When used in conjunction with corresponding measures of landscape stability, biotic integrity, and watershed function, the BSCSI can be used to help determine the relative health of grassland and sagebrush communities.

3. Implement livestock management strategies to reduce disturbance in areas where BSC represent 15% or more of the ground cover. :

- locate livestock watering and salt supplements on sites with low crust potential
- disperse livestock supplements throughout the grazing area
- limit livestock numbers, the site specific levels to be determined under the following range conditions: (1) areas of coarse grained or sandy soils with low water holding capacity (2) periods of low water availability (low annual precipitation and drought prone areas. Winter grazing reduces impacts to soil crusts when snow covered and has also been shown to be beneficial to vascular plant communities), (3) steep slopes, ridges and escarpments, (4) areas recovering from natural disturbance such as drought and fire.

4. Confine recreational vehicles and uses to designated roads, trails and campsites. Encourage low-density use in sensitive areas. Promote late fall or winter use by hikers, backpackers and animal packers. Provide educational opportunities and information on the importance and value of biological crusts.

5. Identify, map and protect from human related disturbances any remaining areas (refugia) where BSC represent 50% or more of the total ground cover (These are unlikely to represent more than 0.1% of the GRDA). This action provides for the conservation and recovery of naturally occurring BSC that can then serve as ecological reference sites for evaluation of responses to mitigation and monitoring activities. Although it is feasible to restore crusts by inoculating disturbed areas with crust layers salvaged and stored prior to disturbance projects, it is much easier and cheaper to conserve existing BSC.

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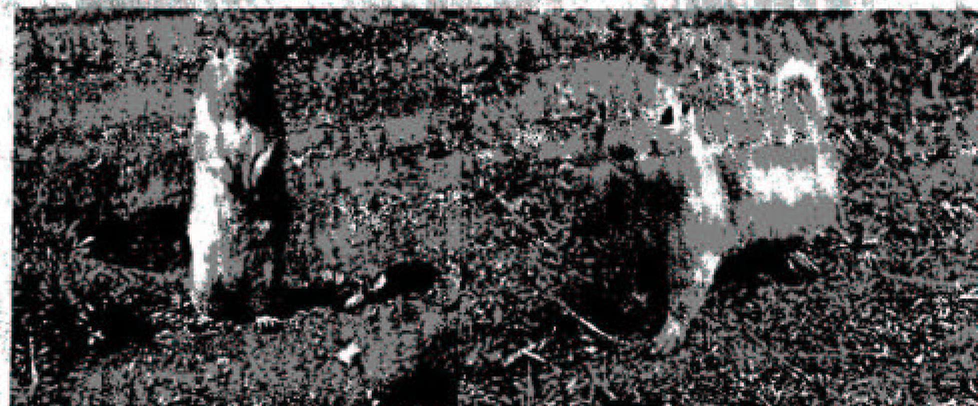
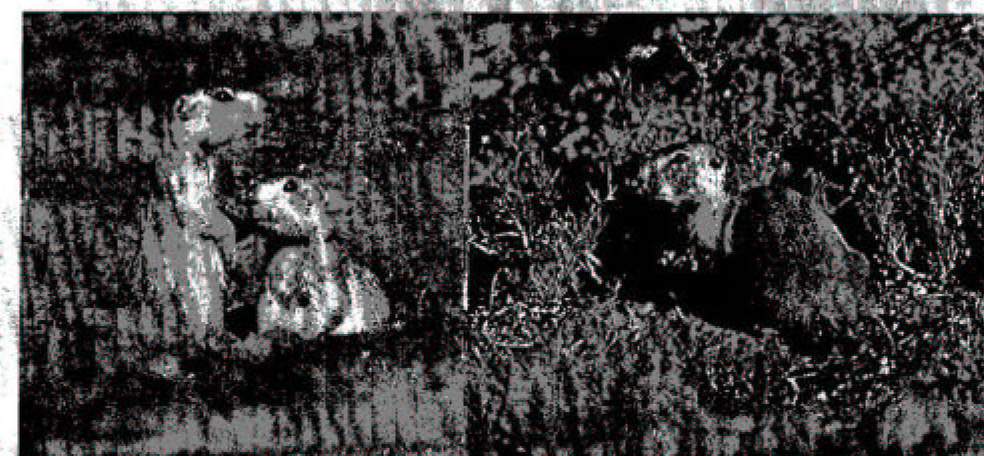


STATUS OF WHITE-TAILED AND GUNNISON'S PRAIRIE DOGS



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STATUS OF WHITE-TAILED AND GUNNISON'S PRAIRIE DOGS

November 2002

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Craig Knowles received a Ph.D. in Zoology from The University of Montana in 1982. His dissertation project investigated the ecology and management of black-tailed prairie dogs in north-central Montana. He has worked on prairie dogs and associated species for over 20 years, published 8 papers on prairie dogs and mountain plovers and written many agency reports on prairie dogs and associated species. His work on prairie dogs and associated species has included black-footed ferret surveys and monitoring, prairie dog management plans, prairie dog translocation projects, statewide prairie dog inventories for North Dakota and Montana, and mountain plover and burrowing owl surveys. In 1995, Craig conducted a range-wide status report for the black-tailed prairie dog that was similar, in many ways, to this report on the white-tailed and Gunnison's prairie dogs. Craig works for FaunaWest Wildlife Consultants in Boulder, Montana.

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PREFACE

Mark Van Putten
President and CEO
National Wildlife Federation

Michael Bean
Chair, Wildlife Program
Environmental Defense

The importance of prairie dogs to the grassland ecosystems of North America is matched only by the degree to which that importance is misunderstood, misrepresented and minimized.

Prairie dogs play a keystone role in maintaining prairie ecosystems. Dozens of species of animals, including mammals, birds, reptiles and amphibians are dependent to one degree or another on prairie dogs for food, shelter or both. Without the prairie dog, the vast American grassland ecosystems cannot survive.

But for the better part of the last century, humans waged a *de facto*, and sometimes open, war of attrition against prairie dogs. Poisoning, loss of habitat, unregulated "sport" shooting and sylvatic plague, an introduced disease to which prairie dogs have little or no immunity, decimated them. Seldom has such a war been so ill-advised and misguided.

Sadly, the consequences of this persecution and mismanagement are clear. All five species of prairie dogs now merit concern. The Utah prairie dog is classified as threatened. The Mexican prairie dog is endangered. Following a 1998 petition filed by the National Wildlife Federation, the black-tailed prairie dog, the most widely distributed and numerous species, is currently a "candidate" species awaiting a threatened listing by the US Fish and Wildlife Service.

But little attention has been paid to the conservation status of the white-tailed and Gunnison's prairie dogs. What is clear, however, is that both of these species of prairie dogs are greatly depleted in abundance and distribution and that wildlife managers need more information to assess their status. Managers also need to raise the priority for management and conservation efforts for these species.

This survey is a contribution toward that end. The information contained within has been collected from scientific, historic and popular literature, and from reports and impressions from federal, state and regional land managers whose areas of supervision include prairie dog habitat. This report is the first effort to look at the status of these two species across their entire geographic range.

The National Wildlife Federation and Environmental Defense are pleased to provide this information as a resource for land and wildlife managers working with white-tailed and Gunnison's prairie dogs, as well as for individuals concerned with the conservation efforts surrounding these two species. We hope the information provided here will assist in these efforts and help overcome the political and organizational obstacles that stand in the way of managing prairie dogs as wildlife species essential to restoring and maintaining America's threatened grassland ecosystems.

Mark Van Putten,
President and CEO
National Wildlife Federation
Reston, VA

Michael Bean, Chair
Wildlife Program
Environmental Defense
Washington, DC

FINDINGS and RECOMMENDATIONS

It is clear that after years of mismanagement and outright persecution, both the white-tailed and Gunnison's prairie dogs are clearly greatly depleted in abundance and distribution. With some notable exceptions, little is being done to address their plight.

More information on these two species is critical to reversing their decline and ensuring the health of the grasslands ecosystems to which they are an integral part.

Through collection of information from the scientific, historic and popular literature on prairie dogs, as well as the reports and impressions of federal, state and regional land mangers, the following conclusions can be made.

- Most states have badly neglected these species and there is little reliable information on their status or current trends.
- Both species have been greatly reduced in overall abundance, though there has been little contraction in their overall geographic range (that is, these species occur throughout most of the area they have historically occupied, but in far fewer places and in smaller colonies).
- The causes of the continuing declines are unclear, but likely the results of many factors. While species suffered greatly from poisoning campaigns in the last century, it is not currently a serious decimating factor. With the exception of those in Montana, habitat conversion is less an issue with these two species than for black-tailed prairie dogs. While both the white-tailed and Gunnison's species are highly susceptible to plague, the lower density of their colonies puts them at lower risk than black-tailed prairie dogs.
- The Gunnison's prairie dog is apparently more threatened than its white-tailed cousin. This is due to the survival of two extant mega-complexes of white-tailed colonies (Shirley Basin, Wyoming and northwestern Colorado and eastern Utah). These account for between 50 and 75% of the remaining white-tailed prairie dog habitat acreage. Both these mega-complexes, however, lie within the plague zone.
- Although some 493,000 acres of white-tailed prairie dog colonies have been recently mapped, it is clear that others remain unknown. Far more information is needed. Agency staff reports that populations are "stable" are typically based more on personal perceptions than on hard-and-fast data and studies.

In combination, this information portrays the serious lack of complete data on these two important species. To remedy the situation, state and federal agencies must move quickly to learn more and to collect definitive information on current population status and trends. At the same time, they should implement safeguards to prevent further population declines.

Such efforts can begin through collaboration among states, following the model of the black-tailed prairie dog planning efforts to establish targets for adequate and minimum numbers of acres that should be occupied by each species in each state.

Where appropriate, these should include colonies large enough to maintain the ecological function of these species in supporting the black-footed ferret, burrowing owl and other wildlife species that depend on healthy prairie dog populations. If these targets are not met, states should determine in advance how they will respond.

Agencies must also take aggressive measures to develop population monitoring techniques and protocols and to employ systematic monitoring for plague and plague impacts

The status of white-tailed and Gunnison's prairie dogs must be changed from that of a varmint or nuisance species to one that gives state fish and game agency biologists prime responsibility for their management, rather than state agriculture departments.

State game agencies must establish hunting regulations that prohibit shooting during periods in the spring when young prairie dogs are emerging from burrows and are most vulnerable. They must collect systematic information on amount and effectiveness of ongoing poisoning efforts on private lands and encourage and support efforts and research to develop techniques to manage plague impacts on prairie dog populations. Finally, agencies need to conduct information/education campaigns that will help separate myth from reality with respect to prairie dogs impacts on rangelands.

The National Wildlife Federation and Environmental Defense thank Dr. Craig Knowles for putting together this survey. We realize, and even hope, that this status report will be shown to be incorrect following additional surveys and studies. Only weeks before this report was printed we received additional information from Colorado Division of Wildlife biologists indicating more extensive areas of prairie dogs than was reported in the first draft of this report. Although we were able to incorporate these Colorado reports, we have no doubt that the status of these species elsewhere may be (or will soon become) either better or worse than reported here. This is especially true in areas where there is plague. For this reason it is important to periodically evaluate the status of these species on a range-wide basis and we hope that this report will stimulate such efforts.

Sterling Miller

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EXECUTIVE SUMMARY

The status of the white-tailed and Gunnison's prairie dogs was investigated by conducting telephone interviews with agency people knowledgeable about these species within their area of jurisdiction. Available literature on prairie dog taxonomy, and life history and ecology was also reviewed. The white-tailed and Gunnison's prairie dogs are considered distinct species with no recognized subspecies. Both species are colonial, hibernate during the winter, and occur in shrub-grassland and grassland habitats in the Intermountain West. Density of white-tailed prairie dogs within colonies (2-5 prairie dogs per acre) is typically less than densities of Gunnison's prairie dogs within colonies (5-10 prairie dogs per acre). Wildlife species closely associated with black-tailed prairie dogs are also found in association with white-tailed and Gunnison's prairie dogs. The white-tailed prairie dog occurs from extreme southcentral Montana (1% of the range), south through much of Wyoming (71% of the range) into western Colorado (16% of the range), and northeastern Utah (12% of the range). This represents a potential range distribution of about 40,651,000 acres. The Gunnison's prairie dog occurs in northern Arizona (30% of its range), southwestern Colorado (22% of its range), northwestern New Mexico (45% of its range), and extreme southeastern Utah (3% of its range). The Gunnison's range distribution is approximately 67,121,000 acres. There is no evidence of significant geographic range contraction on a broad scale, but since both species are colonial, loss of colonies during the past century due to poisoning, sylvatic plague, and habitat loss are range reductions. Presettlement populations of both species are unknown, but prairie dog control records for New Mexico suggest the Gunnison's prairie dog was once very common. The decline of the Gunnison's prairie dog from the mid-20th century to the present, due to sylvatic plague, an introduced disease, is documented in the literature. In at least some areas, series of plague epizootics have sequentially reduced Gunnison's prairie dog populations to low levels. The two largest white-tailed prairie dog complexes, one in Wyoming and one in Colorado/Utah, have been influenced by plague, as well. For both species, some survivors of plague epizootics have tested sero-positive for plague, suggesting the potential for genetic resistance to plague. Plague is clearly the most significant factor affecting prairie dog populations range-wide for both species. Limited prairie dog poisoning continues on private land, but there were no reports of recent organized government-sponsored programs to eradicate prairie dogs from large areas. Recreational shooting of both species does occur, but in most areas it is considered as a secondary population impact. Colorado and Arizona have recently restricted prairie dog shooting on public lands at least during spring, and Utah has restricted shooting of Gunnison's prairie dogs. Loss of habitat due to agricultural land conversion and urbanization is important on a local scale, but is not considered a significant range-wide impact. Individual agency reports with varying levels of empirical support, suggested that white-tailed and Gunnison's prairie dog populations are generally stable to declining. Plague was frequently cited as a recurrent event and was identified as the cause of declining populations or the factor preventing populations from increasing. Outside of black-footed ferret reintroduction areas in Wyoming, Colorado, Utah, and Arizona, there is little current information on prairie dog occupied acreage and trend for either species. Many prairie dog colonies have been mapped over the past two decades in relation to specific energy projects, but most of these data are now antiquated and have not been incorporated into a single data base. There is a need, especially with the Gunnison's prairie dog, to conduct a range-wide population inventory.

INTRODUCTION

Prairie dogs (*Cynomys*), unlike ground squirrels (*Spermophilus*), are unique to North America. Within the genus *Cynomys*, there are five species. Early accounts of the black-tailed prairie dog (*Cynomys ludovicianus*) suggest that this was a very abundant species on the Great Plains (Merriam 1901). Although similar accounts of the white-tailed and Gunnison's prairie dogs (*Cynomys leucurus* and *Cynomys gunnisoni*) are apparently lacking, it is assumed that these were also highly successful species within their distributional range. The 20th century was, without any question, a period of drastic decline for all prairie dog species. Although the prairie dog distributional range has not contracted greatly, it is estimated that overall black-tailed prairie dog populations have declined by 99% (Miller and Cully 2001, Van Putten and Miller 1999). It is feasible that a similar scenario may exist for the white-tailed and Gunnison's prairie dogs. However, there is little historical information available to provide an adequate baseline for any figure on percent decline in occupied area.

Three major factors account for these declines.

1. From the start of the settlement process, Federal and state governments have led and assisted numerous attempts to exterminate prairie dogs (all species). These efforts are well documented (Merriam 1901, Burnett and McCampbell 1926,

Cates 1937, BLM 1982, Hanson 1989). It is clear that an organized assault on prairie dogs with poisoned grain baits has the ability, over time, to extirpate prairie dogs from local areas. Cycles of prairie dog poisoning campaigns are generally initiated when prairie dogs increase to occupy about 0.5% of the regional landscape, and control efforts are generally suspended when prairie dog colonies are reduced below 0.1% of the landscape (Knowles 1995). Prior to settlement, historic accounts suggest that prairie dogs occupied from 3 to 20% of regional landscapes (Knowles 1995).

2. As prairie dogs were cleared from the land through the use of toxicants, many former prairie dog colonies were put into agricultural croplands. As long as these lands are cropped, it is doubtful that prairie dogs will ever be permitted to recolonize agricultural lands. Agricultural lands represent a permanent loss of prairie dog habitat and significantly influences prairie dog distribution.

3. The third major event of the 20th century was the introduction of sylvatic plague (*Yersinia pestis*) into North America. Prairie dogs appear to have little or no immunity to this disease. In some areas, plague has had an absolutely devastating effect on prairie dog populations (e.g., South Park Colorado, see Eke and Johnson 1952). Plague has the potential to reduce prairie dogs to levels lower than encountered during organized poisoning campaigns. Directed prairie dog poisoning in concert with sylvatic plague has the potential of extirpating prairie dogs on a regional basis. The long-term consequences of these three major prairie dog population impacts remain a subject of debate. Will fragmented and isolated prairie dog populations persist over the long-term, or will repeated catastrophic events (plague epizootics and poisoning) progressively move prairie dog populations toward extinction?

While prairie dogs have persisted at low levels in many areas despite these major population impacts, some species associated with prairie dogs have not demonstrated persistence in the absence of large prairie dog colony complexes. The long-term persistence of these species is not assured. The black-footed ferret (*Mustela nigripes*) is an obligate prairie dog predator and is among the most endangered of the North American mammals. The ferret would have gone extinct without direct intervention to conserve the species through captive propagation. The mountain plover (*Charadrius montanus*) is a near prairie dog obligate, and its populations continue to decline up to the present. Federal listing of this species as threatened is pending. The burrowing owl (*Athene cunicularia*) within the range of prairie dogs has declined almost proportionately in relation to the availability of prairie dog habitat. A similar scenario probably exists for the ferruginous hawk (*Buteo regalis*).

In recent years, considerable conservation effort has been focused on the black-tailed prairie dog. The black-tailed prairie dog is highly colonial and occurs in grassland and shrub/grassland habitats on the Great Plains. Its colonial habits make this a conspicuous species that is highly vulnerable to poisoning campaigns. Virtually all colonies in a given area can be located and mapped making this an easy species to monitor and control. The white-tailed prairie dog is less colonial (i.e., they occur in lower densities), is more tolerant of shrubs in its colonies, and is less conspicuous making monitoring colony complexes more difficult. Consequently, prairie dog poisoning campaigns against this species were less effective than against the black-tailed prairie dog, and conservation concerns have not been as great. The colonial behavior of the Gunnison's prairie dog is intermediate between the black-tailed and white-tailed prairie dogs, and the Gunnison's prairie dog has also been subject to intensive control campaigns. In addition, sylvatic plague can, and has, significantly impacted both the Gunnison's and white-tailed prairie dogs in all areas of their range distributions. These two species have a considerably smaller range distribution than black-tailed prairie dogs, and within their range they are frequently restricted by mountain topography. Moreover, compared to the black-tailed prairie dog, these species occur with lower densities within their colonies and likely have much smaller range-wide populations. If there is cause to be concerned with long-term black-tailed prairie dog persistence, then there certainly could be concern for long-term population persistence of the white-tailed and Gunnison's prairie dogs. This paper examines published information on these species and the most current information from management agencies to develop a status report based on best available information.

METHODS

The status of the white-tailed and Gunnison's prairie dogs was investigated by conducting telephone interviews with Bureau of Land Management (BLM), Forest Service (FS), US Fish and Wildlife Service (FWS), state wildlife agency, and university personnel knowledgeable about these species within their areas of jurisdiction. The interviews included questions on status and trend of prairie dogs, prairie dog occupied acreage figures (where available), the presence of plague, recreational shooting, poisoning, and associated species. The reliance upon personal communications was necessary for this report because there were little published information or agency reports on the status of white-tailed and Gunnison's prairie dogs. Interview process provided an opportunity to discuss the status of these species with professional biologists who had at least casual observations of prairie dogs for multiple years within their administrative areas. In some cases, biologists had unpublished data on systematic surveys of specific prairie dog complexes. State and Federal agencies were not given Freedom of Information Act requests for prairie dog status data because adequate cooperation was obtained through the interview process. Available literature on prairie dog taxonomy, life history, and ecology was also reviewed. A draft of this report was distributed to the interviewees and others in December 2001 along with a request for corrections and additions. Where appropriate, comments received by September 2002 were reviewed and integrated into this version.

TAXONOMY

Prairie dog taxonomy is critical to interpreting the severity of threats to the Gunnison's and white-tailed prairie dogs, and possible subspecies. The Mexican prairie dog was considered endangered by the US Fish and Wildlife Service (FWS) before the Endangered Species Act (ESA) was signed into law in 1973. The Utah prairie dog was listed as endangered in 1973 and down-listed to threatened in 1984. The black-tailed prairie dog is listed as a candidate threatened species. Only the white-tailed and Gunnison's prairie dogs are not currently listed by the FWS. In July 2002, a petition to list white-tailed prairie dogs was jointly filed by the Center for Native Ecosystems, Biodiversity Conservation Alliance, Southern Utah Wilderness Alliance, American Lands Alliance, and Forest Guardians (Center for Native Ecosystems et al. 2002).

Two subgenera are recognized within the genus *Cynomys*. These two subgenera are represented by prairie dogs with black-tipped tails and prairie dogs with white-tipped tails. The first group consists of the black-tailed prairie dog and the Mexican black-tailed prairie dog (*Cynomys mexicanus*), which is a relict black-tailed prairie dog population. The second group consists of the Gunnison's prairie dog, white-tailed prairie dog and Utah prairie dog (*Cynomys parvidens*). The Utah prairie dog is a relict white-tailed prairie dog population.

Based on work by Pizzimenti (1975), the current taxonomic classification for the white-tailed prairie dog group is as three separate species with no recognizable subspecies within any of the species. Pizzimenti (1975) considered the white-tailed and Utah prairie dogs to be very closely related and stated that separate species designation was warranted only because the two species were ecologically separated from each other by the Wasatch and Fish Lake Plateaus.

The Gunnison's prairie dog was formerly considered to consist of a northern and southern subspecies – the Gunnison's (*C. g. gunnisoni*) and Zuni (*C. g. zuniensis*) prairie dogs, respectively (Hollister 1916). A more recent analysis of the genus *Cynomys* by Pizzimenti (1975) concluded that there was insufficient evidence to support subspecies status within the Gunnison's prairie dog.

This analysis of the white-tailed prairie dog group is not accepted by all mammalogists. At one extreme are Burt and Grossenheimer (1964) who considered all members of the white-tailed group to be a single species with three recognizable subspecies (Gunnison's, white-tailed, and Utah prairie dogs). At the other extreme are other credible mammalogists who accept the three species classifications and also consider the Gunnison's prairie dog to consist of two recognizable subspecies (Hubbard and Schmitt 1984, Fitzgerald 1991). This subspecific split was based on color differences. Gunnison's prairie dogs found in the southwestern portion of their range have a noticeably different colored pelage. The southwestern individuals were described as "redder" by Pizzimenti (1975) and as "paler" by Hubbard and Schmitt (1984). However, these color variations were not reflected in discernable morphologic measurements or measurable genetic differences (Pizzimenti 1975).

In Colorado, the Continental Divide separates the two Gunnison's prairie dog populations. In New Mexico the Divide trends southwest while the divisional line between the two Gunnison's populations trends southeast. There is no real geographic barrier that separates the subspecies in this area and there is a reported zone of integration (Pizzimenti 1975). However, the two populations are partly separated by mountain ranges (G. Schmitt, pers. commun.) that minimize the zone of contact. It is important to understand this relationship of the two Gunnison's populations because the northeastern population has suffered disproportionate losses due to plague during the past half century.

Based on Pizzimenti's (1975) work, it is doubtful that the single species concept for the white-tailed group expressed by Burt and Grossenheider (1964) is valid. There is sufficient genetic and morphological evidence to conclude that there are three separate species within the white-tailed prairie dog subgenera. The classification of the Gunnison's prairie dog into two subspecies remains controversial. Pizzimenti's (1975) work has been criticized for its small sample size and poorly selected locations for prairie dog collections. In this paper, I accept the analysis of Pizzimenti (1975) that the white-tailed and Gunnison's prairie dogs are separate species and that the Gunnison prairie dog does not consist of a northern and southern subspecies, but the reader needs to be aware that the conclusions of Pizzimenti (1975) are not accepted by all mammalogists. A study of Gunnison's prairie dog DNA is currently ongoing and should clarify whether two subspecies should be recognized (Leachman pers. commun.).

DISTRIBUTION

Relative to black-tailed prairie dogs, white-tailed and Gunnison's prairie dogs are very restricted distributionally. West of the Continental Divide, both species are confined to montane valleys and plateaus of the Intermountain West, and east of the Divide they occur in upper drainage basins (Figures 1 and 2). Collectively, these two species range from about 34° to 45° N latitude, and from 105° to 113° W longitude. This distribution can be compared to black-tailed prairie dogs with a distribution on the Great Plains ranging from about 29° to 49° N latitude, and 98° to 111° W longitude. Collectively, these two species have an original range distribution less than a third of that for the original range of black-tailed prairie dogs. Black-tailed prairie dogs are associated with grassland habitats throughout much of the Great Plains from southern Canada to northern Mexico and this species is both the most widespread (400 million acres of potential range) and numerically abundant (perhaps 10 million individuals) of the five prairie dog species. At the other extreme, Utah prairie dogs have the smallest range and population size (5,000 individuals in 2000 [Bonzo and Day 2000]).

The white-tailed prairie dog occurs from extreme southcentral Montana (1% of the range), south through much of Wyoming (71% of the range) into western Colorado (16% of the range), and northeastern Utah (12% of the range) (Figure 1). This represents a potential range distribution of about 40,651,000 acres. It occurs both east and west of the Continental Divide in Wyoming and Colorado. However, only a small portion of the range in Colorado is east of the Divide and this portion is an extension of the range up the North Platte and Laramie River Valleys from Wyoming. Many of the sites occupied by the white-tailed prairie dog east of the Divide in Wyoming are probably too dry for black-tailed prairie dogs. Worland and Riverton, with 7.4 and 7.6 inches annual precipitation, respectively, are out of the range of black-tailed prairie dogs, but Casper, with 11.9 inches annual precipitation, is within the range of black-tailed prairie dogs.

Pizzimenti (1975) presented a distributional range map for white-tailed prairie dogs showing a small sliver of range distribution extending into northwestern New Mexico. However, this is not in agreement with others who indicate white-tailed prairie dogs do not occur in New Mexico (Hall 1981, Hubbard and Schmitt 1984, and Armstrong 1972). The southern portion of the white-tailed prairie dog range is shown as disjunct from the northern portion of the range in Colorado (Armstrong 1972) and Utah (Utah Gap Analysis 1997), but Hall (1981) shows the range as continuous through this area. My presentation of range distribution (Figure 1) follows Armstrong (1972) and Utah Gap Analysis (1997) and my calculations of range size are based on this distribution. The reason for this gap in range distribution is not clear, but it may have implications concerning conservation of the species. The majority (71%) of the white-tailed prairie dog range distribution occurs in Wyoming, and it is apparent that Wyoming provides very important habitat for this species. The distributional range of the white-tailed prairie dog overlaps with the black-tailed prairie dog in southcentral Montana and northcentral Wyoming and individuals of each species have been observed in the same colony (Hollister 1916, D. Flath, pers. commun.). Hall (1981) shows a marginal white-tailed prairie dog record at the intersection of the Wyoming, Utah, and Idaho borders. Potentially, some white-tailed prairie dogs could occur in southeastern Idaho, but the Idaho Natural Heritage Program does not include the white-tailed prairie dog on its sensitive species list, and it appears that this species does not occur in Idaho.

The Gunnison's prairie dog occurs in northern Arizona (30% of its range), southwestern Colorado (22% of its range), northwestern New Mexico (45% of its range), and extreme southeastern Utah (3% of its range) (Figure 2). The Gunnison's range distribution is approximately 67,121,000 acres with Arizona and New Mexico accounting for almost three quarters of the range distribution. The Gunnison's prairie dog range distribution is about 65% larger than the white-tailed prairie dog, but only about 17% of the size of the black-tailed prairie dog range distribution. This species is found both east and west of the Continental Divide in Colorado and New Mexico, but east of the

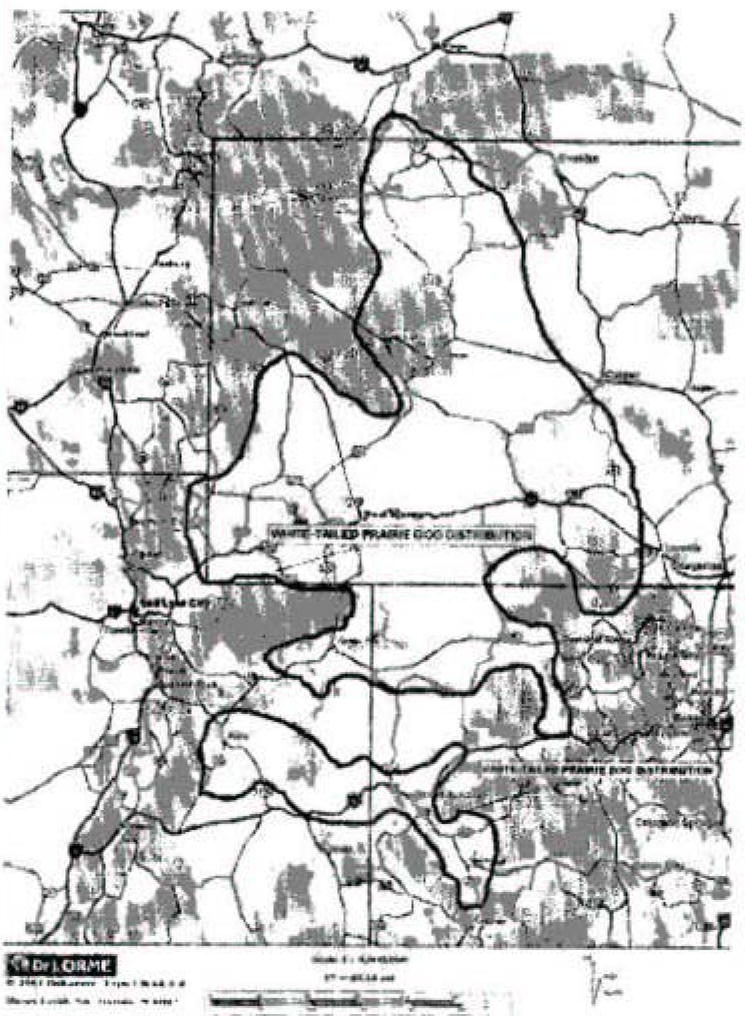

Figure 1. Map of the geographic range distribution for the white-tailed prairie dog.

Divide it is restricted to upper drainage basins. The Gunnison's prairie dog has potential range overlap with the black-tailed prairie dog in southcentral Colorado, northeastern New Mexico, and southwestern New Mexico. The distributional map presented in Figure 2 is based on Armstrong 1972, Hubbard and Schmitt 1984, Van Pelt 1995, and Utah Gap Analysis 1997.

The white-tailed and Gunnison's prairie dogs have distributional range overlap in west-central Colorado (Figures 1 and 2). In the Gunnison Valley, from the Delta area to the Montrose area, the two species potentially occur in the same general area.

My conversation with agency personnel did not reveal any specific areas where a significant portion of the white-tailed or Gunnison's prairie dog geographic range distributions have contracted. Kelso (1939) reported collecting white-tailed prairie dogs near Billings, Montana in the 1930s. This species currently occurs about 40 miles south of this area (Flath 1979). Greg Schmitt (pers. commun.) reported Gunnison's prairie dogs to have expanded their range eastward into the Las Vegas, New Mexico area as the more colonial and conspicuous black-tailed prairie dog was eliminated through control efforts. Since prairie dogs are colonial and are not broadly distributed over the landscape like other rodents, such as deer mice (*Peromyscus maniculatus*), contraction or expansion of prairie dog colonies represents distributional changes. A 90% reduction in acres occupied by prairie dogs should be considered as a 90% reduction in range distribution. Even though marginal prairie dog records, which define the geographical range, may not have changed significantly during the past century, in a general sense there has been range contraction of all prairie dog species through habitat alteration, introduced disease, and control efforts. At the heart of this issue is a quantitative assessment of this loss. Any estimate of range contraction is speculative since there were no accurate accounts of prairie dog abundance prior to settlement.

ECOLOGY AND LIFE HISTORY

All five prairie dog species share similar life history strategies and autecology. Prairie dogs are associated with grassland and shrub/grassland habitats (Koford 1958, Tileston and Lechleitner 1966, Longhurst 1944). They prefer relatively level ground, usually with slopes less than 12-15% (Knowles et al. 1982, Slobodchikoff et al. 1988). All prairie dogs are semi-fossorial and construct their own burrows, but mounds are less developed by Gunnison's and white-tailed prairie dogs (Scheefer 1947, Tileston and Lechleitner 1966). Prairie dogs are highly social, living in densely to loosely organized colonies that are organized into small family groups (King 1955). Prairie dogs breed only once a year and typically have 4 to 5 young (Knowles 1987, Cully 1997, Hoogland 2001). However, the number of young surviving to emergence is frequently less than the *in-utero* litter size. Reproduction in the yearling age class can be highly variable ranging from a few breeders to the majority breeding (Hoogland 2001). For a rodent, prairie dogs are considered to reproduce slowly (Hoogland 2001). The literature does not contain any records of multiple litters per year, or young becoming sexually mature prior

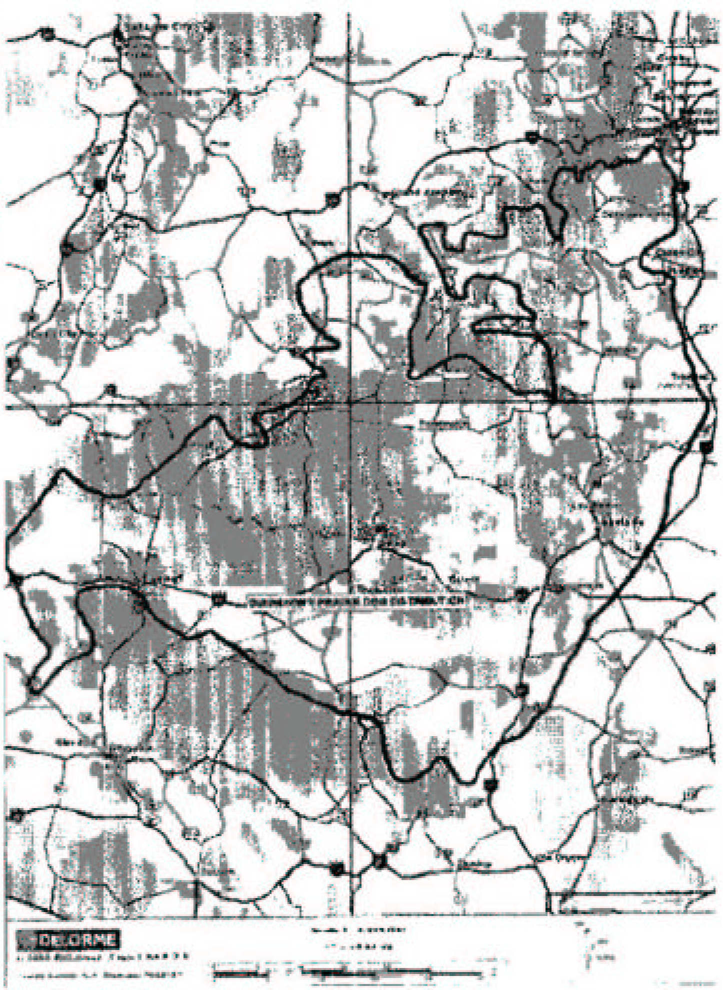

Figure 2. *Map of the geographic range distribution for the Gunnison's prairie dog.*

to one year of age. Prairie dog annual mortality rates are generally in the range of 30-60% (King 1955, Tileston and Lechleitner 1966, Cully et al. 1997).

Prairie dogs are largely herbivorous, taking both grasses and forbs (Kelso 1939, Slobodchikoff et al. 1988). Their preference is for grasses, but forbs are readily taken when they are the dominant vegetation in a colony. Prairie dogs during certain periods of the year may feed heavily on seeds. All prairie dogs are capable of living without free water. The association of prairie dog colonies with livestock water sources and valley bottomlands is related to intensive livestock grazing pressure on these sites (Knowles 1986a, Slobodchikoff et al. 1988). The white-tailed and Gunnison's prairie dogs are hibernators and may even estivate during late summer. While the black-tailed prairie dog is capable of hibernation, only prairie dogs on the northern portion of its range occassionally appear to hibernate for short periods during winter.

Habitat use by white-tailed and Gunnison's prairie dogs differs somewhat from the black-tailed prairie dog primarily due to the strikingly different geographical settings within the range distribution of these three species. The black-tailed prairie dog is primarily a prairie species, while the white-tailed and Gunnison's prairie dogs are associated with intermountain valleys, benches, and plateaus that offer prairie-like topography and vegetation. These intermountain valleys, benches, and plateaus can range from very arid to mesic. In contrast, precipitation within the short- and mixed-grass prairies occupied by black-tailed prairie dogs generally varies from 12 to 20 inches on an annual basis. For the most part, white-tailed prairie dogs are associated with dryer sites while Gunnison prairie dogs occupy mesic plateaus and higher mountain valleys, as well as arid lowlands.

Black-tailed prairie dogs generally occur at higher densities within their colonies than white-tailed and Gunnison prairie dogs (King 1955, Tileston and Lechleitner 1966, Fitzgerald and Lechleitner 1974). Table 1 provides some comparative densities of the three major prairie dog species. Variation in prairie dog density between colonies within a species can be attributed to quality of habitat. Productivity of a site as determined by soil fertility and precipitation is a major factor. Estimates of prairie dog density also vary seasonally. Peak densities occur when pups emerge from natal burrows in late spring, and the lowest densities occur just prior to pup emergence following a full year of natural mortality that can reduce a prairie dog population by 30-60% (King 1955, Tileston and

Table 1. A comparison of summer prairie dog density and burrow density for white-tailed, Gunnison's and black-tailed prairie dogs.

PRAIRIE DOGS/ACRE	BURROWS/ACRE
WHITE-TAILED PRAIRIE DOGS	
0.3-2.0, Clark 1977	10.5, Clark et al. 1982
	10.1, Campbell & Clark 1981
2.5-3.2, Tileston & Lechleitner 1966	11.3, Tileston & Lechleitner 1966
	10.5, Martin & Schroeder 1979
	13.0, Martin & Schroeder 1980
2.3-6.5, 5.2 ave. Biggins et al. 1993	15.6-43.9 Biggins et al. 1993
GUNNISON'S PRAIRIE DOGS	
4.9, Fitzgerald & Lechleitner 1974	23.1 Fitzgerald & Lechleitner 1974
6.9-10.1, Rayor 2985	13.0, Clark et al. 1982
1.6-5.8, 2.9 ave. Van Pelt 1995	
BLACK-TAILED PRAIRIE DOGS	
27.2, Davis 1966	53.1, Davis 1966
8.5-12.1, O'Meilia 1980	68.5, O'Meilia 1980
6.3, Tileston & Lechleitner 1966	41.9, Tileston & Lechleitner 1966
2.0-7.4, Koford 1958	27.0, Koford 1958
5.4-15, King 1955	54.8, King 1955
1.6-12.4, Knowles 1982	41.5, Knowles 1982
12.3-33.4, Garret et al. 1982	

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Lechleitner 1966, Cully et al. 1997). Also important in determining prairie dog density within a colony are mortality factors such as plague, poisoning, and recreational shooting. Understanding prairie dog population density is important because prairie dog abundance is frequently expressed in terms of acres of land occupied by colonies. The assumption is sometimes made that the actual prairie dog population is directly proportional to the total acres of occupied prairie dog habitat. An average prairie dog density multiplied by occupied acres can provide a rough estimate of total prairie dog numbers. Such estimates are probably more appropriate for the black-tailed prairie dog than the white-tailed and Gunnison's prairie dogs. Accurately mapping white-tailed and Gunnison's prairie dog colonies can be challenging because they occur in lower densities and modify the vegetation less than black-tailed prairie dogs. In addition, white-tailed and Gunnison's prairie dogs can estivate and hibernate making it difficult during some periods to determine if a colony is abandoned or if the prairie dogs are simply dormant (W. Stroh, pers. commun.).

Black-tailed prairie dogs are considered to be densely colonial, to have highly-developed social behavior, and to utilize a variety of vocalizations and visual signals. The white-tailed prairie dog is only loosely colonial and has fewer vocalizations than the black-tailed prairie dog (Waring 1970). The Gunnison's prairie dog is reported to be smaller and more like ground squirrels in its behavior and morphology, but frequently it is reported to occur in high density colonies where the vegetation is obviously influenced by their activities (Rayor 1985). Based on these differences, Pizzimenti (1975) considers the Gunnison's prairie dog to be ancestral or primitive, the black-tailed prairie dog to be advanced, and the white-tailed prairie dog as intermediate between them.

PRESETTLEMENT POPULATIONS

Early naturalists during the 1800s were very qualitative on their assessment of western wildlife. Occasionally there were descriptions of prairie dog colonies based on quantitative estimates (e.g., miles long, acres) (Bouroughs 1961, Messiter 1890, Merriam 1901). However, during this period, even if someone had wanted to map a colony, it really was not possible due to the lack of accurate maps and land surveys. During the early 1900s, the land was surveyed and accurate maps were developed, but during this period the goal was total extermination of prairie dogs (Merriam 1901, Taylor and Loftfield 1924, Burnett and McCampbell 1926, Alexander 1932, Cates 1937) and there was no interest in documenting what was to be destroyed. However, early land use classification surveys were conducted by trained surveyors and they frequently outlined prairie dog colonies on their maps (Flath and Clark 1986). These records are maintained by counties and railroads and would require a special effort to locate and review the original maps, but they do provide an index to prairie dog abundance early in the settlement process (Flath and Clark 1986).

There is very little historical information on the abundance of white-tailed and Gunnison's prairie dogs prior to settlement (Clark 1973, Anderson et al. 1986). Research of journals written by 19th century explorers and naturalists might yield some qualitative descriptions of white-tailed and Gunnison's prairie dogs, but I have not seen cited accounts in the literature as is frequently the case with black-tailed prairie dogs. Clark (1973) stated that the presettlement abundance of white-tailed prairie dogs in Wyoming was unknown. Similarly, the presettlement abundance of Gunnison's prairie dogs was also unknown. Anderson et al. (1986) found no historic records of Gunnison's prairie dog abundance for Arizona, Colorado, and Utah. For New Mexico, they cited Hubbard and Schmitt for an estimate of black-tailed and Gunnison's prairie dogs in 1919 (discussed below).

Hollister (1916) gives an account of white-tailed and Gunnison's prairie dog distribution based on personal communication with late 1800s naturalists, but his paper does not address abundance. Early prairie dog control efforts by Federal, state, and county government agencies often reported on an annual basis by state, and sometimes by county, how many acres of prairie dogs (and other rodents) were treated with poison grains to document that their rodent eradication programs were effective (see Armstrong 1972, BLM 1982, Clark 1989). Although these records were not intended to document the acres of prairie dogs in existence, they can serve as an indirect accounting of prairie dog distribution and abundance shortly after settlement.

WYOMING

Bob Luce (pers. commun.) provided some historical information on the white-tailed prairie dog in northwestern Wyoming in the general area of Meeteetse, site of the last known wild black-footed ferret population and the source of all captive and reintroduced ferrets. From the files of the US Department of Agriculture's Animal Damage Control, a letter from 1915 describes in general terms the white-tailed prairie dog population north of the Greybull

River, east of the Forest boundary, and west of the Cody-Meeteetse Road. Within this area an estimated 200,000 acres of white-tailed prairie dogs existed in 1915 with an average of six burrows per acre. Clark et al. (1986) noted that private prairie dog control efforts began in this area in the 1880s, but 1915 was the first year for organized prairie dog control by the Federal government. Luce (pers. commun.) noted that in 1981 when ferrets were discovered at Meeteetse, there were 12,172 acres of prairie dogs in this same area (6% of 1915 estimates). Since that time prairie dog acreage in the same area has declined to less than 1,000 acres, or more than a 99% reduction from the 1915 prairie dog acreage estimate.

NEW MEXICO

Poisoning records indicate that both Gunnison's and black-tailed prairie dogs were once far more abundant in New Mexico than they are currently. Unfortunately, these records are unclear about which species were poisoned. It is possible, however, to make some inferences about the former abundance of prairie dogs in New Mexico based on the number of acres reported poisoned, information about the efficacy of the poison used, and knowledge of other factors like plague. In this analysis it is necessary to assume that declines in numbers of acres poisoned are directly related to declines in the number of acres available to be poisoned.

Hubbard and Schmitt (1984) tabulated prairie dog control in New Mexico from 1914 through 1981 for the Gunnison's and black-tailed prairie dogs (Figure 3). During the period of 1917-1932, New Mexico conducted its first big poisoning campaign against prairie dogs (black-tailed and Gunnison's prairie dogs) with approximately 11,150,000 acres being treated with poison grain bait (Figure 3), but for most of this period there was no information to suggest how many acres of each species were poisoned, or how many of the acres were treated more than once. Generally, strychnine grain bait was used during the 1920s and 1930s (Clark 1989). Contemporary evaluation of strychnine grain bait shows that 70-90% population reductions can be achieved with a single treatment of strychnine (Sullins 1980), and that with this level of control, pretreatment populations can be achieved within five years (Knowles 1986b) if there is no follow-up control work. Obviously, some of the documented prairie dog control reported by Hubbard and Schmitt (1984) represented second treatment of colonies where prairie dogs survived initial control efforts and attained some level of repopulation.

For the period 1931 through 1957, Hubbard and Schmitt (1984) were able to determine the control effort conducted within the range of the Gunnison's prairie dog in New Mexico (Figure 4). Poisoning of the Gunnison's prairie dog peaked in 1935 with approximately 1,750,000 acres being treated in that year. From 1933 through 1943, approximately 8,550,000 acres of Gunnison's prairie dogs were treated with poisoned grain bait. I selected this period for analysis because it represents a complete cycle of an intensive poisoning campaign. Presumably the campaign ended when prairie dogs were sufficiently reduced and were no longer considered an agricultural threat. During this 11-year period, there would have been opportunity for some prairie dog colonies to recover from poisoning and these might have been treated twice. Thus, the actual number of acres of prairie dog colonies treated a single time would have been less than 8,550,000 acres. However, the 1930s poisoning campaign was the second attempt in New Mexico to eradicate prairie dogs (Figure 3), and prairie dog populations during this period were probably already reduced by prior poisoning efforts.

Even if singly-treated Gunnison's prairie dog colonies accounted for only half of the estimated 8,550,000 treated acres from 1933 through 1943, this would mean that Gunnison's prairie dog colonies physically occupied about 14% of its overall geographic range distribution in New Mexico. The implication of this analysis is that New Mexico once had a large Gunnison's prairie dog population that may have exceeded 4,500,000 acres of occupied landscape. Hubbard and Schmitt (1984) cite Shriver (1965) who estimated prairie dog (both species) abundance in New Mexico in 1919 at 11,951,000 acres or about 15.3% of the total landscape. A 1980s estimate of Gunnison's prairie dog abundance in New Mexico showed that

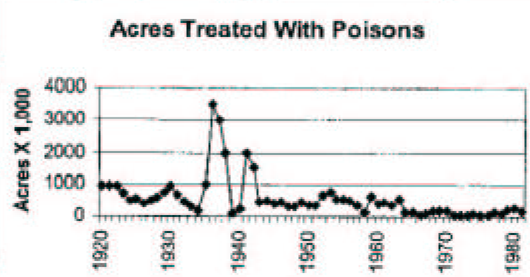

Figure 3. *Acres of Gunnison's and black-tailed prairie dog colonies treated with poison from 1914 to 1981 in New Mexico (data from Hubbard and Smith 1984).*

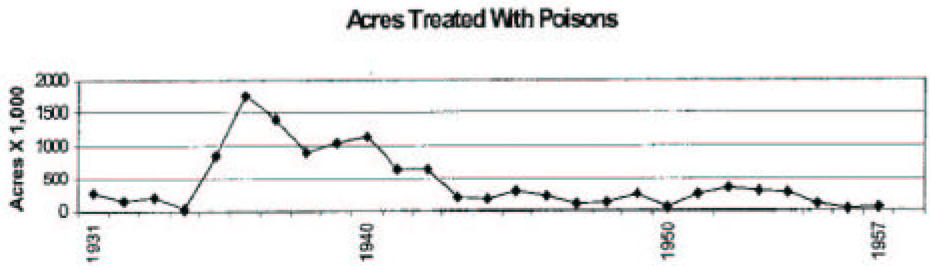

Figure 4. Acres treated with poison to control rodents and lagomorphs in New Mexico within the range of the Gunnison's prairie dog from 1931 to 1957 (data from Hubbard and Smith 1984).

Gunnison's and black-tailed prairie dogs had not recovered from earlier control efforts. A map presented by Hubbard and Schmitt (1984) based on data collected by Bodenchuck (1982) shows that total Gunnison's prairie dog colony acres did not exceed 1% of county acreages within its range in New Mexico (summarized in Figure 5). In 11 of the 16 counties within the distributional range of Gunnison's prairie dogs, the estimated acreage was less than 0.25% of the county acreage. If the Gunnison prairie dog occupied an average of 0.25% of its range distribution in New Mexico in 1982, then there would have been approximately 75,000 acres of prairie dog-occupied land. This should be contrasted with an estimated 8,550,000 acres of Gunnison's prairie dogs poisoned in the late 1930s and early 1940s.

Other evidence supporting a substantial decline in prairie dog abundance in New Mexico is evident in a declining prairie dog control effort from the 1950s through 1960s (Figure 3). During this period, there was a gradual decline in prairie dog control when Compound 1080 was available for prairie dog control (up to 99% efficacious (Sullins 1980)), plague was present, and there were no legal restrictions on prairie dog poisoning. It can be assumed that the amount of poisoning indirectly reflects the acres of prairie dog colonies available to poison. Compound 1080 was a very effective prairie dog control agent and the declining use of poisons during this period suggests that prairie dogs were in gradual decline. In 1972, use of Compound 1080 on Federal lands was banned by two executive orders.

Hubbard and Schmitt (1984) note that there were several records from the early 1900s to suggest that the black-tailed prairie dog in New Mexico was very abundant, but there are few notes about the abundance of the Gunnison's prairie dog. The fact that there is no quantitative information on presettlement prairie dog populations should be of no surprise. Throughout much of the range of the Gunnison's and white-tailed prairie dogs today, there is a similar lack of information despite a much reduced prairie dog population and dramatically improved mapping techniques.

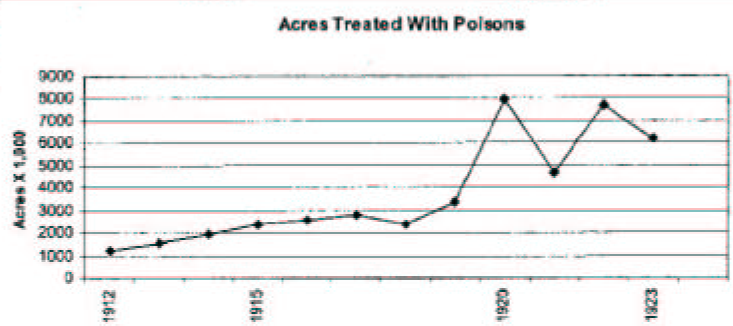

Figure 5. Number of acres in Colorado treated annually with poisoned grain bait from 1912 to 1923 (data from Clark 1989).

COLORADO

A similar scenario was documented in Colorado. Clark (1989) summarized a series of reports by Burnett from 1912 through 1923 that reported on the number of acres treated in Colorado with poison grain baits. These reports do not differentiate the control effort directed at each of the three prairie dog species in Colorado, but Burnett and McCampbell (1926) make it clear that Gunnison's prairie dogs in southwestern Colorado were part of this control effort. During this 12-year period, approximately 44, 600,000 acres of prairie dogs and ground squirrels were treated with poison grain bait in Colorado. Data for this early poisoning effort are displayed in Figure 6 and are adapted from Clark (1989).

In addition to quantitative changes in Gunnison's prairie dog acreages, there have probably been qualitative changes in the occupied acreages. Two early accounts of the Gunnison's prairie dog in Colorado (Burnett and McCampbell 1926, Longhurst 1944) suggest that the primary habitat for this species was located in the main valley bottoms and that prairie dog density in these sites were higher than found in the secondary habitat located on plateaus and high-elevation mountain meadows. Burnett and McCampbell (1926) reported 63 prairie dogs and 245 burrow openings per acre on one ranch near Cortez, Colorado. Longhurst (1944) reported prairie dog densities in cleared fields and natural openings in the main valleys to range from 15 to 30 prairie dogs per acre. These figures are much higher than any contemporary information on Gunnison's prairie dog density (see Table 1).

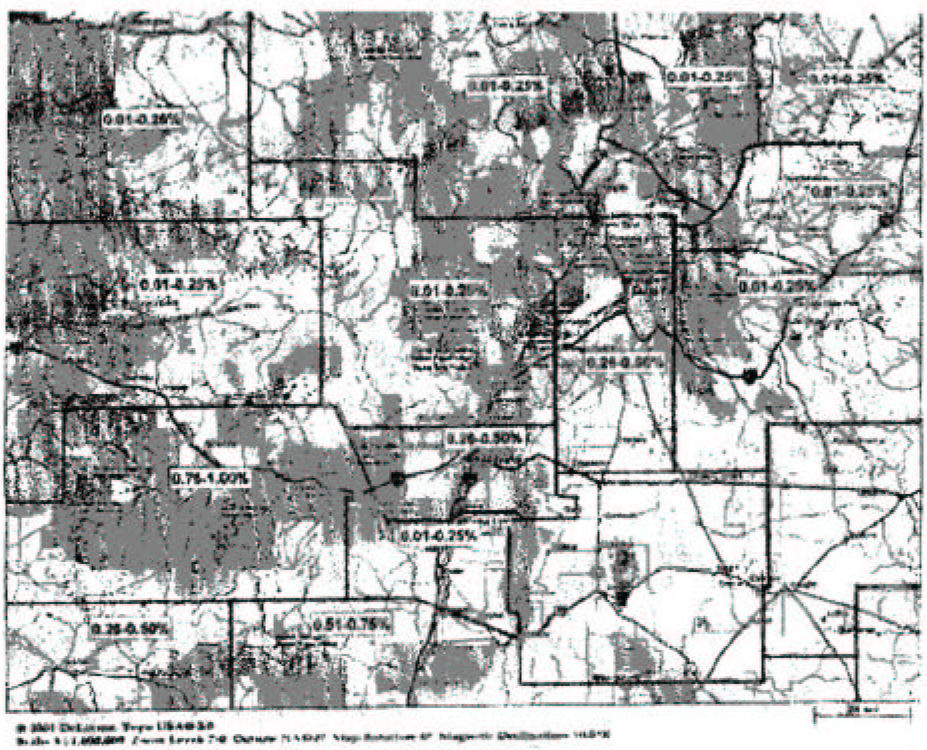

Figure 6. Estimated percent of county area occupied by the Gunnison's prairie dog in New Mexico (data from Hubbard and Smith 1984).

THREATS TO WHITE-TAILED AND GUNNISON'S PRAIRIE DOGS

AGRICULTURAL LAND CONVERSION

Agricultural land conversion in conjunction with poisoning has been a major cause of decline for all prairie dog species during the last century. Development of irrigated hay, crop, and pasture lands was the primary cause for the near extinction of the Utah prairie dog (Crocker-Bedford and Spillett 1981). Gunnison's and white-tailed prairie dogs have also been displaced from some of the more productive valley bottomlands in Colorado and New Mexico (Longhurst 1944), and there are still reports of poisoning of these species on private bottomlands (J. Ferguson, D. Heft, pers. commun.). Agricultural land conversions have contributed to range contraction of the white-tailed prairie dog in Montana, both historically and in recent years (Parks et al. 1999). In Wyoming, however, loss of prairie dog habitat to agricultural land conversion is believed to be significant only in the Bighorn Basin; in other areas of Wyoming it is not considered an important factor (R. Luce, pers. commun.).

URBANIZATION

Displacement of the Gunnison's prairie dog through urbanization has occurred in the Albuquerque, Santa Fe, and Flagstaff areas of New Mexico and Arizona (R. Leglar, W. Van Pelt, pers. commun.). Overall, however, loss of habitat to urbanization is significant only on a local basis and is not a range-wide concern for either species. Arizona permits the capture and relocation of prairie dogs being displaced by urbanization (W. Van Pelt, pers. commun.). Similar prairie dog relocation programs are permitted in New Mexico.

POISONING

Poisoning of the Gunnison's and white-tailed prairie dogs was significant early in the settlement process. On Federal lands in Arizona, the Gunnison's prairie dog did not recover from these early control efforts (W. Van Pelt, pers. commun.). Based on the report by Hubbard and Schmitt (1984), it is apparent that the Gunnison's prairie dog has suffered a similar fate in New Mexico. In Colorado, Gunnison's prairie dogs were largely eliminated from major valleys during the first half of the 20th century (Burnett and McCampbell 1926, Longhurst 1944) and those in the higher valleys were subjected to control efforts during the 1950s (Lechleitner et al. 1968). However, during this period, Colorado and New Mexico were experiencing plague epizootics and at least some of the decline in prairie dogs can be attributed to plague (Lechleitner et al. 1968).

Poisoning, however, continues to the present on private lands (J. Capridice, J. Ferguson, J. Cresto, J. Hansen and D. Heft, R. Leachman, pers. commun.). The FWS reviews about 12-20 applicants each year to poison white-tailed prairie dogs on private lands in western Colorado (R. Leachman, pers. commun.). Some of these may be residential requests of minor conservation consequence. The BLM occasionally receives requests to control prairie dogs on Federal lands, but such requests are generally denied (L. Apple, R. Leglar, D. Heft, C. Cesar, J. Cresto, M. Albee, J. Ferguson, pers. commun.). Minor exceptions included a specific request to keep prairie dogs away from a residence (J. Hansen, pers. commun.), but requests to poison on Federal lands by livestock producers are generally denied. Apparently, Curecanti National Monument considered poisoning Gunnison's prairie dogs on their lands to reduce the risks of tourists contracting plague from Gunnison's prairie dogs, but that plan was never implemented (J. Capridice, pers. commun.). It appears that prairie dog control on Federal lands is no longer a conservation issue.

For fiscal year 1999, Wildlife Services of the US Department of Agriculture reported the use of 9,130 fumitoxin tablets and four gas cartridges for control of white-tailed prairie dogs, the use of 266 pounds of zinc phosphide grain bait for control of Gunnison's prairie dogs, and shooting 72 and 101 white-tailed and Gunnison's prairie dogs, respectively (this information, plus summary reports for other years, is available online on the Wildlife Services home page). To private individuals during the same year, they supplied 37,900 fumitoxin tablets and 2,338 gas cartridges for control of Gunnison's prairie dogs and 180 pounds of zinc phosphide grain bait for white-tailed prairie dog control. Wildlife Services also consulted with 24 individuals on control of white-tailed prairie dogs, and they made 116 consultations on the control of Gunnison's prairie dogs. Also in 1999, they received 21 complaints about white-tailed and Gunnison's prairie dogs ranging from a single individual prairie dog in a suburban area to a complaint about 1,712 acres of prairie dog infested rangeland. State departments of agriculture or livestock may also be involved with prairie dog control, but the level of involvement may vary among states. Prairie dog poisoning on private lands can be conducted without Federal or state assistance or oversight, and there has been no systematic attempt to quantify this activity. Frequently, agency personnel state that poisoning is no longer an issue with prairie dogs because of plague, but my experience with black-tailed prairie dogs in Montana and North Dakota is that poisoning remains a common practice that is conducted on Federal lands by, I assume, private individuals. For example, within the exterior boundaries of the Little Missouri National Grassland, approximately a quarter of the black-tailed prairie dog colonies I examined in 2002 showed direct or indirect evidence of poisoning.

SYLVATIC PLAGUE

Without any question, sylvatic plague is the major influence on Gunnison's and white-tailed prairie dog populations today. Virtually all wildlife biologists interviewed stated that plague was the dominant controlling factor of prairie dogs in their area of jurisdiction. There appears to be no area where plague has not impacted these two species (a possible exception may be Aubrey Valley, Arizona). Plague entered the range of both these species during the late 1930s to the late 1940s (Lechleitner et al. 1968, Cully 1993). Published accounts for Gunnison's prairie dogs show that mortality from plague frequently exceeds 99% (Lechleitner et al. 1968, Rayor 1985, Cully et al. 1997). Cully et al. (1997) reported that about 40% of the few Gunnison's prairie dogs found to survive plague epizootics have positive plague titers, suggesting that there is an extremely small (less than half of 1%) portion of the population with some immunity to plague. William Stroh (pers. commun.) reported three white-tailed prairie dogs with positive plague titers.

Generally, Gunnison's prairie dogs are considered more vulnerable to plague than white-tailed prairie dogs. Bureau of Land Management (BLM) biologists with Gunnison's prairie dogs within their area of jurisdiction, reported no large colonies, with 80- to 200-acre colonies being the upper size limit due to plague (E. Brecky, J. Capridice, J. Hansen, D. Heft, pers. commun.). (An exception is Aubrey Valley, Arizona, which has no documented plague outbreaks and retains large prairie dog colonies (W. Van Pelt, pers. commun.)). An explanation for this differential susceptibility between white-tailed and Gunnison's prairie dogs is not apparent, but it has been suggested that Gunnison's prairie dogs occur in higher densities and create conditions more conducive for a plague epizootic.

Population recovery following plague appears to be variable and different patterns have been reported. In some areas there appears to have been no significant recovery. This pattern is reported for Gunnison's prairie dogs in South Park, Colorado (R. Leachman, pers. commun.) and for white-tailed prairie dogs near Meeteetse, Wyoming (D. Biggins, pers. commun.). Cully et al. (1997) reported a different pattern for Gunnison's prairie dogs in his northern New Mexico study area. Here, prairie dogs partially recovered following a plague epizootic, but failed to recover following a second epizootic (J. Cully, pers. commun.). Other reports for the Gunnison's and white-tailed prairie dogs suggest a pattern where colonies are regularly lost due to plague, but new colonies develop and grow in other areas; this pattern may yield populations that are stable over a larger geographic area (P. Bilbeisi, D. Heft, J. Hansen, L. Apple, pers. commun.). Dave Wagner (pers. commun.) reports a similar situation in northern Arizona with the Gunnison's prairie dog, where there have been substantial declines due to plague. However, at the same time, Arizona's largest complex has been increasing 8% annually since 1992. Observations of these patterns to date are largely anecdotal and not based on careful mapping. However, monitoring on portions of the two largest white-tailed prairie dog complexes shows a clear cyclic pattern of abundance in response to plague epizootics. There are concerns that plague cycles result in successive population peaks that are progressively lower than the previous peak. There are also concerns that with each new epizootic, the loss of colonies from plague will exceed the rate of establishment of new colonies.

In Colorado and New Mexico, plague impacts for the Gunnison's prairie dog are well documented (Ecke and Johnson 1952, Lechleitner et al. 1968, Fitzgerald and Lechleitner 1974, Fitzgerald 1989, Cully 1997). South Park, Colorado was described as containing 913,000 acres of Gunnison's prairie dog colonies in 1941 prior to the advent of plague (Ecke and Johnson 1952). Plague entered this area in 1947, and by 1949 plague had reduced the prairie dog acreage by more than 95%. Epizootics of plague continued in this area through the 1950s and 1960s (Lechleitner et al. 1962, Fitzgerald and Lechleitner 1974) and prairie dogs were nearly eliminated from South Park. Currently this area contains only a few hundred acres of prairie dog colonies (R. Leachman, pers. commun., E. Brecky, pers. commun.). Former colonies are now occupied by Wyoming ground squirrels (*Spermophilis elegans*) and 13-lined ground squirrels (*Spermophilis tridecemlineatus*).

Fitzgerald (1991) became so concerned with the loss of Gunnison's prairie dogs in South Park, that he formally requested the FWS to investigate their status in Colorado. South Park was an area where Fitzgerald had previously studied Gunnison's prairie dogs for a book on Colorado mammals, and he was cognizant of the magnitude of the loss. In response, the FWS contracted for a cursory ground survey conducted within the Colorado Gunnison's prairie dog distributional range. The findings of this survey (Findley 1991) were consistent with Fitzgerald's observations of substantial declines in the Gunnison's prairie dog in Colorado.

Although less well documented, plague in white-tailed prairie dogs has had a range-wide impact (R. Luce, M. Albee, J. Cresto, W. Stroh, R. Lambert, J. Ferguson, P. Belbeisi, D. Biggins, pers. commun., Parks et al. 1999). None of the people interviewed suggested that white-tailed prairie dogs in their area of jurisdiction had escaped plague. Near Meeteetse, Wyoming, the white-tailed prairie dog complex supporting black-footed ferrets went from about 7,000 acres to about 500 acres following a plague epizootic. This complex has not recovered during the 14 years following the plague epizootic. However, other colonies in the general area, but outside the area once used by ferrets, have expanded during the same period (D. Biggins and R. Luce, pers. commun.). The Shirley Basin prairie dog complex is extremely large and has shown a variable response to plague with declining prairie dog numbers in some areas and increasing prairie dogs in other areas (R. Luce, pers. commun.). At one time, the Shirley Basin prairie dog complex occupied an estimated 340,000 acres (R. Luce, pers. commun.), and currently there are an estimated 142,000 acres in the complex (R. Luce, pers. commun.). This decline in prairie dog numbers is attributed to plague and the monitored portion of the complex where ferrets have been reintroduced is now on its third plague-induced cycle since monitoring began in 1991 (R. Luce, pers. commun.). However, this area represents only 47,540 acres of this complex, and prairie dogs outside of this area have been noted qualitatively to increase over the past 11 years (R. Luce, pers. commun.).

White-tailed prairie dogs in the northwestern portion of Colorado and northeastern portion of Utah have been noted to go through plague cycles, as well. There is little pre-plague information, but in recent years these prairie dog complexes have been mapped and despite the cyclic nature of epizootic and enzootic stages of plague, prairie dogs are believed to be less abundant now than 20 years ago (D. Biggins, pers. commun.). William Stroh (pers. commun.) suggested that his area in northeastern Utah is experiencing a slow gradual decline in prairie dog density despite relatively little change in prairie dog acreage. Dean Biggins (pers. commun.) is studying plague in these areas and suggests that plague is always active, but in most years prairie dog mortality from plague is small and localized, and usually goes unnoticed. It is only during epizootics that kill large areas of prairie dogs that the loss of prairie dogs is noticed.

Colonies recovering from plague have been observed to have enhanced reproductive rates, as would be expected in populations of mammals with artificially low densities. In Aubrey Valley Arizona, Gunnison prairie dogs surviving a plague epizootics, grew faster, matured earlier, had larger litters at weaning, and had higher juvenile survivorship compared to colonies not impacted by plague (Cully 1997).

RECREATIONAL SHOOTING

Recreational shooting of prairie dogs can have negative population consequences (Knowles 1988, Vosburgh and Irby 1998). Recreational shooting of both species does occur and was noted during agency interviews. Many of the agency biologists stated that shooting was limited to a small number of local shooters and had not attracted large numbers of nonresident shooters such as observed with black-tailed prairie dog shooters (M. Albee, J. Hansen, J. Ferguson, E. Hollowed, J. Cresto, R. Legler, D. Heft, pers. commun.). However, where larger white-tailed prairie dog colonies exist there appears to be some serious prairie dog shooting (L. Apple and C. Breckenridge, W. Wichers, pers. commun.), and others noted that there is a need to monitor shooting (M. Albee, pers. commun.). There were reported to be no serious shooters in the area of Lander, Wyoming, but there were serious shooters on larger white-tailed prairie dog colonies in the Rawlings, Wyoming area (C. Breckenridge, pers. commun.). Recreational shooting of Gunnison's prairie dogs in Arizona can be a significant impact on some colonies (D. Wagner, pers. commun.), but the effect of shooting may be confounded by the presence of plague (W. Van Pelt, pers. commun.). Arizona hunter survey data indicated that 91,000 Gunnison's prairie dogs were shot in 2000 (W. Van Pelt, Black-tailed Prairie Dog Conservation Team Meeting 29 Aug. 2001). The controversial competition prairie dog shoot in the early 1990s in southwestern Colorado was directed at Gunnison's prairie dogs in the Nucla/Naturita area. The controversy associated with this shoot led to a bag limit imposed on organized competition shoots. However, this shooting event has died a natural death as a result of plague reducing prairie dog densities in this area below a point that could sustain competition shooting (J. Ferguson, pers. commun.). Similar observations of plague and shooting have been made in Wyoming (W. Wichers, pers. commun.).

Most prairie dog shooters are unaware of the existence of more than one prairie dog species and cannot differentiate among the species, resulting in indiscriminate prairie dog shooting (W. Whichers, pers. commun.). However, the lack of out-of-state shooters dominating in the shooting of Gunnison's and white-tailed prairie dogs in some areas is related to the fact that large high density colonies do not occur with sufficient frequency to entice dedicated nonresident prairie dog shooters to this area. This is compounded by the presence of shrubs and lower prairie dog densities in white-tailed and Gunnison's prairie dog colonies. However, there are dedicated local shooters that are very persistent in seeking out and finding even small prairie dog colonies for shooting purposes (J. Hansen, pers. commun.). There is some concern that shooting of Gunnison's prairie dogs at small colonies can have a severe impact (J. Capridice, pers. commun.). The overall impact of prairie dog shooting is unknown, but some agency personnel indicated the need for regulations to govern this activity. Arizona (closed 1 April through 15 June), Colorado, and Utah have imposed, or are in the process of imposing, some seasonal restrictions on prairie dog shooting to protect pregnant and lactating females during spring. Montana now has a year-around closure on the shooting of white-tailed prairie dogs on Federal lands in the portion of Carbon County where the remaining white-tailed prairie dogs occur. Like black-tailed prairie dog shooting regulations, there are no restrictions on shooting any species of prairie dog on state or private lands in Montana. It is unclear whether the closure on shooting white-tailed prairie dogs on Federal lands in Montana is enforced or if prairie dog shooters are aware of the difference in regulations for the two species. Montana's black-tailed prairie dog shooting season opens on June 1, which may be too early to protect highly vulnerable newborn prairie dogs when they first emerge from burrows. Seasons in neighboring Wyoming (proposed) and South Dakota open on June 15 so the early Montana opening for prairie dog shooting may also funnel shooters into Montana during the first half of June. Because the distribution of white-tailed prairie dogs is so limited and their status so precarious in Montana, it is important that posting and active enforcement of the shooting restrictions occur.

CURRENT STATUS - WHITE-TAILED PRAIRIE DOG

MONTANA

Very few white-tailed prairie dogs occur in Montana. Kelso (1939) stated that he collected white-tailed prairie dogs in the vicinity of Bridger and Billings, Montana for his food habits study in the 1930s. Hollister (1916) described the white-tailed prairie dog distribution in Montana as the Clarks Fork River and Sage Creek (drainage on the west side of the Pryor Mountains and part of the upper Bighorn River drainage basis). Hoffmann and Pattie (1968) described the white-tailed prairie dog distribution in Montana as the Clark Fork River and its tributaries. Flath (1979) describes the location of 15 known white-tailed prairie dog colonies totaling 773 acres in southcentral Montana between Bridger, Montana and the Montana/Wyoming state line. By 1997 only 2 of these 15 colonies remained and the status of one colony was undetermined (FaunaWest 1998). Subsequently, an additional three small colonies were found and there is an additional unconfirmed report of a fourth small colony (D. Flath, pers. commun.). These known colonies total about 120 acres. The cause of this decline is believed to be a combination of plague and agricultural land conversion (Parks et al. 1999).

The white-tailed prairie dog in Montana has been in decline since the settlement of southcentral Montana during the early 1900s. This decline continues to the present. There has been a decline in range distribution in Montana and also a decline in the percent of the landscape occupied within current range distribution. The Montana Fish, Wildlife, and Parks Department and the BLM developed a draft environmental assessment (EA) (Parks et al. 1999) to reintroduce white-tailed prairie dogs into abandoned colonies, but to date, this draft EA has not been put out for public comment. One of the surviving prairie dog colonies is located primarily on Forest Service lands, and the other colonies are on BLM and private land. In one case a colony is located on a highway right-of-way. Based on the historic and recent trends in Montana, without direct conservation intervention there is a real risk of white-tailed prairie dog extirpation in Montana.

WYOMING

Seventeen major white-tailed prairie dog colony complexes in Wyoming were surveyed in the late 1980s early 1990s to evaluate them as black-footed ferret reintroduction sites, as illustrated in Figure 7 (R. Luce, pers. commun.). At that time, there was about 340,000 acres of active prairie dog colonies, about 142,000 acres of this area was in the Shirley Basin complex. Subsequent to the ferret-evaluation estimate, the large Kinney Rim complex has declined due to plague; the status of the other complexes evaluated for ferret reintroduction is uncertain and needs investigation (W. Wichers, pers. commun.). In addition, there are apparently additional smaller complexes that have

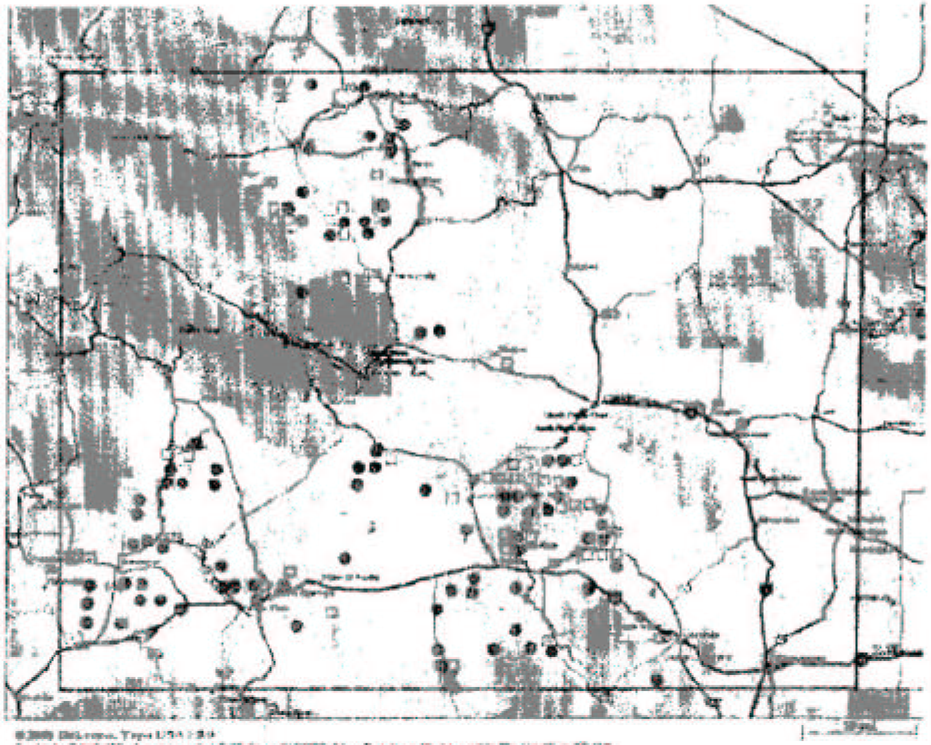

Figure 7. Distribution of Wyoming townships with 1,000 to 2,000 acres of white-tailed prairie dogs (circles) and more than 2,000 acres of white-tailed prairie dogs (squares) (mapping date from 1988 to 1989, Wyoming Game and Fish).

never been mapped. The status and size of these smaller complexes are unknown. The distribution of townships with 1,000-2,000 mapped acres, and the location of townships with more than 2,000 mapped acres of white-tailed prairie dog colonies in Wyoming, are illustrated in Figure 8.

Wyoming Game and Fish (WGF) has monitored white-tailed prairie dog population trends on the northern 20,000 acres of the Shirley Basin complex. Plague was first documented in the Shirley Basin complex in 1986 and the first documented decline in prairie dogs within the ferret reintroduction area came after 1992. Prairie dogs recovered somewhat in 1996, declined again, and increased in 2001 (R. Luce, pers. commun.). Dean Biggins (pers. commun.) considers the Shirley Basin complex to be half of its original pre-plague size with no clear trend of recovery and characterized the Shirley Basin as being in a "Meeteetse situation."

The Meeteetse white-tailed prairie dog complex has been monitored since the discovery of ferrets in this area in the early 1980s. Prairie dog acreage has declined from about 7,000 acres in 1986 to 500 acres currently. This complex has shown no signs of recovery. Clark et al. (1986) were able to determine that this complex occupied about 20,750 acres in 1930 prior to a major poisoning effort. An adjacent smaller complex south of the Grey Bull River not used by ferrets in the early 1980s has not experienced plague epizootics and has increased in size during the same period (D. Biggins and R. Luce, pers. commun.). My own observations in 1983-1984 indicated the presence of numerous old prairie dog mounds in this area, so this does not represent pioneering colonization of new habitat. In Montana, the frequently mapped large black-tailed prairie dog complexes serve as useful indicators of regional prairie dog population trends.

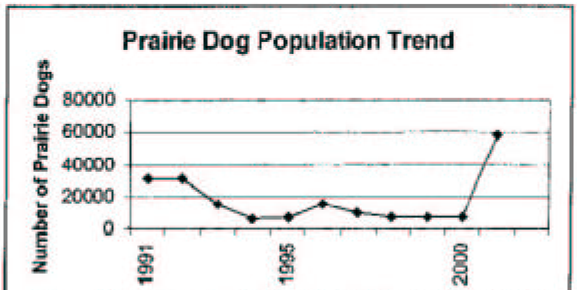

Figure 8. Population trend of the white-tailed prairie dog in PMZ1 of the Shirley Basin complex in southcentral Wyoming (data are from Grenier 2002).

However, the impacts of plague and poisoning are not uniformly distributed, and applying local trends to a statewide prairie dog population is not advisable. Overall, Wyoming white-tailed prairie dog populations are reported to be stable, and 340,000 acres is still considered to be the best estimate of their abundance (R. Luce, pers. commun.). Individual BLM offices contacted in Wyoming all reported no systematic mapping nor monitoring of prairie dogs in their areas of jurisdiction. Given this, and the documented declines in the Meeteetse and Shirley Basin complexes, it is difficult to evaluate the accuracy of the general impressions reported for Wyoming.

COLORADO

A statewide effort to map white-tailed and Gunnison prairie dogs is currently underway in Colorado. As a preliminary step toward this mapping, during July and August 2002, field biologists with the Colorado Division of Wildlife, the US Forest Service and the Bureau of Land Management collaborated to draw polygons of active white-tailed and Gunnison's prairie dog colonies on 1:50,000 scale maps (P. Schnurr pers. commun.). Colonies were considered "active" if prairie dogs were known by these personnel to have been present within the last three years and the active area was sketched on maps. A total of 125,766 acres of "active" white-tailed prairie dog colonies in Colorado were determined during this exercise (Table 2, Colorado Division of Wildlife 2002). There are an additional 53,832 "active" acres in Delta County where the biologists were uncertain whether these areas were occupied by white-tailed or Gunnison's prairie dogs (Table 2). In addition to these "active" acres, 46,104 acres were identified using the same procedure for areas where white-tailed prairie dogs were known to have been previously present but where their current presence was unknown (Colorado Division of Wildlife 2002). The 125,766 acres identified as "active" are considered by the Colorado Division of Wildlife to be a preliminary minimum estimate of the number of acres occupied by white-tailed prairie dogs in Colorado. The polygons sketched on maps during 2002 will serve as the basis for identifying strata for subsequent range-wide field surveys that will be completed by mid-summer of 2003 (P. Schnurr, pers. commun.).

During the 1980s, in an effort to identify prairie dog complexes suitable for black-footed ferrets, major complexes were identified and mapped. Reexamination of some of these areas could not find a general pattern of decline in burrow density; by the 1980s prairie dogs were likely already impacted by plague (D. Biggins, pers. commun.). This effort has shown that prairie dogs in northwestern Colorado experienced a plague epizootic in 1984-1985 and populations were reduced 74-100% (E. Hollowed, pers. commun.). This has been followed by periods of population recovery followed by minor epizootics. The current population estimate is believed to be about 60% of the pre-plague population (E. Hollowed, pers. commun.). White-tailed prairie dog complexes in the northwestern corner of Colorado were identified as the best available ferret habitat in the State, and these complexes have a history of monitoring effort. Rio Blanco and Moffat Counties are thought to have the majority of white-tailed prairie dogs in Colorado (L. Nelson, pers. commun.).

There are currently some pockets of plague activity in the southern portion of the ferret reintroduction area (M. Albee, pers. commun.). In some areas, the prairie dogs have not returned (E. Hollowed, pers. commun.). Hollowed also observed other areas where populations have achieved pre-plague density and distribution, and cited the Coal Oil Basin area as an example. The estimated prairie dog acreage in northwestern Colorado (this includes the Little Snake, Wolf Creek, and Crooked Wash areas) is about 130,000 acres (M. Albee, pers. commun.). This series of prairie dog complexes continues into eastern Utah where there are approximately 23,000 acres of prairie dog colonies in the Coyote Basin, Shiner Basin, and Kennedy Wash areas. This information is presented in detail under the Utah summary. Overall in recent years, there has been no consistent upward or downward trend in this area (my impression gained from conversations with E. Hollowed, M. Albee, and B. Stroh). The BLM provided a landownership composition for Wolf Creek and Coyote Basin prairie

Table 2. Acres in Colorado plotted in 2002 as having "active" colonies of white-tailed and Gunnison's prairie dogs during the period 1999-2002 based on knowledge of field personnel from the Colorado Division of Wildlife, US Forest Service, and US Bureau of Land Management (Colorado Division of Wildlife 2002). Values listed do not include acres where active colonies of these species existed prior to 1999 whose field verification is inadequate to determine status subsequently.

COUNTY	"ACTIVE AREA" OF WHITE-TAILED PRAIRIE DOGS	"ACTIVE AREA" OF GUNNISON'S PRAIRIE DOGS	"ACTIVE AREA" OF SPECIES UNKNOWN	COUNTY	"ACTIVE AREA" OF WHITE-TAILED PRAIRIE DOGS	"ACTIVE AREA" OF GUNNISON'S PRAIRIE DOGS	"ACTIVE AREA" OF SPECIES UNKNOWN
Alamosa		2		Larimer	47		
Archuleta		15,978		Mesa	9,877	0	
Chaffee		2,467		Mineral		449	
Conejos		4,707		Moffat	86,951		
Costilla		14,948		Montezuma		12,223	
Delta			53,832	Montrose		6,482	
Dolores		3,363		Ouray		647	
Douglas		58		Park		42	
Eagle	81			Rio Blanco	19,810		
Garfield	2,004			Rio Grande		12,263	
Gunnison		611		Saguache		2,659	
Jackson	5,996			San Miguel		2,017	
La Plata		6,816		Teller		63	

dog complexes, and 52,400 acres of colonies were on BLM lands (79%), 11,600 acres were on private lands (18%), and 2,250 acres were on state lands (3%). It is assumed that land ownership of prairie dogs elsewhere in western Colorado/eastern Utah would be similar.

In North Park (northcentral Colorado), there are apparently a few white-tailed prairie dog colonies on BLM lands and ten colonies on the Arapaho National Wildlife Refuge totaling perhaps a few hundred acres (C. Cesar, P. Bilbeisi, pers. commun.). Both biologists interviewed considered the population in this area stable during the past 26 years. Plague has been documented in prairie dogs in this area (P. Bilbeisi, pers. commun.). Some colonies have disappeared while others have increased in size.

In the Montrose area in southwestern Colorado, some prairie dog mapping and density work (burrows per acre) was done in 1978 in relation to possible black-footed ferret sightings and pipeline projects, but there is no current comprehensive mapping data (J. Ferguson, pers. commun.). San Miguel County (south of Montrose County) had one of the first documented plague cases in Colorado prairie dogs in the 1940s. Plague events seem more frequent and virulent now, and occur when prairie dog densities are high (J. Ferguson, pers. commun.). In spite of this, Ferguson (pers. commun.) reported that, overall, the white-tailed prairie dog population in this area seemed to be stable. In this portion of southwestern Colorado, the Gunnison's and white-tailed prairie dogs have range distributions that overlap in some areas. Generally, the white-tailed prairie dog occupies lower and drier sites while the Gunnison's prairie dog is found in higher, moister areas.

The BLM provided maps of Gunnison's and white-tailed prairie dog distribution in the Grand Junction area in a 1990 black-footed ferret report (Lambeth 1990). The report lists black-footed ferret survey efforts, but does not discuss prairie dog acreages. The 1990 report contains an addendum that observed, "In about 1989, a marked reduction was noted in the prairie dog population on the public land. Almost everywhere the colonies fell silent. *Yersinia pestis*, being common, was assumed the cause.... Starting in late 1993 some individual prairie dogs could be seen on some of the ghost towns and the population seems in 1994 to continue to build. The same population crash was noted in adjacent Utah and most other parts of the Western Slope of Colorado...."

UTAH

In 2002, a total of 97,786 acres of active white-tailed prairie dog colonies were surveyed in Utah (Utah Division of Wildlife Resources file data). Of these, 87,524 were in northeastern Utah and 10,262 were in southeastern Utah (C. McLaughlin, pers. commun.).

In eastern Utah, the white-tailed prairie dog has experienced similar plague-induced population crashes and recoveries as described for western Colorado. I participated in two black-footed ferret surveys in northeastern Utah and northwestern Colorado (in 1988 and 1989). One project was the proposed 132-mile-long Craig-Bonanza transmission line. This route transected 14.7 miles of white-tailed prairie dog colonies, or about 11% of the landscape along the route was occupied by prairie dogs. The 14.7

miles of transected prairie dog colonies represented 22 separate colonies that occupied 11,696 acres. This route crossed Kennedy Wash, Coyote Basin, and Wolf Creek. Plague was noted in the area in 1985 (Bio/West 1988).

The BLM provided a summary of white-tailed prairie dog mapping data from 1997 to 2000 for Coyote Basin, Shiner Basin, and Kennedy Wash (Table 3). In 2000, there were approximately 23,000 acres of occupied prairie dog colonies in these three areas. The total prairie dog population in this area was estimated at 30,000 individuals. Although the overall mapping data shows a stable to increasing prairie dog acreage for these three areas, these data do not necessarily reflect the same status for the overall population. William Stroh (pers. commun.) cautioned that the areas of high density prairie dogs (shown as percent of area in good habitat) has been declining for all three areas. Apparently, this category is determined from transect data, and this shows an 8-10% annual decline in areas of high density occupancy by white-tailed prairie dogs across the region.

Combined with the northwestern Colorado prairie dogs, the Coyote Basin, Shiner Basin, and Kennedy Wash complex totals approximately 153,000 acres of active prairie dog colonies. This constitutes the largest white-tailed prairie dog complex in the world (W. Stroh, pers. commun.). Should there ever be an accurate accounting of white-tailed prairie dogs, this complex and the Shirley Basin, Wyoming complex would represent more than half of the range-wide white-tailed prairie dog population and might represent as much as 75% of the total population of white-tailed prairie dogs.

White-tailed prairie dogs also occurred in significant numbers in the Moab, Utah area in what is known as the Cisco Desert. Portions of this area were mapped during the 1980s in relation to pipeline projects and black-footed ferret surveys (J. Cresto, pers. commun.). A plague epizootic in 1991 knocked this population down and the current prairie dog distribution and numbers are insignificant compared to the 1980s population (J. Cresto, pers. commun.). Prairie dogs have not recovered in this area and there is no mapping data that would reflect the current distribution and acreage (J. Cresto, pers. commun.). An evaluation of this area by the Utah Division of Wildlife Resources found the large colonies of the 1980 to be reduced to their core areas with the prairie dogs on the fringes gone. There were some new prairie dog colonies. (W. Bates, pers. commun.). Up to 1991, the BLM was working toward black-footed ferret reintroduction on this site, but currently has no such plans. The high frequency of minor plague events in this area makes it difficult to pick out a long-term population trend in the remnant population (D. Biggins, pers. commun.).

Table 3. Summary of white-tailed prairie dog mapping data for Coyote Basin, Shiner Basin and Kenney Wash areas in northeastern Utah (data supplied by the Utah BLM).

CHARACTERISTIC	1997	1998	1999	2000
COYOTE BASIN				
Total area mapped (ac)	10,045	11,216	12,535	12,535
Percent of area in good habitat	91	91	79	77
Area of good ferret habitat (ac)	9,155	10,183	9,859	9,859
Dogs/ac in good habitat	4.6	3.8	4.8	3.6
SHINER BASIN				
Total area mapped (ac)	4,517	10,692	-	10,704
Percent of area in good habitat	96	99	-	40
Area of good ferret habitat (ac)	4,351	10,620	-	4,322
Dogs/ac in good habitat	3.6	4.5	-	1.5
KENNEDY WASH				
Total area mapped (ac)	-	2,960	2,955	2,955
Percent of area in good habitat	-	82	53	48
Area of good ferret habitat (ac)	-	2,426	1,556	1,413
Dogs/ac in good habitat	-	4.2	3.3	3.5

White-tailed prairie dogs are found in Emery and Carbon counties west of the Cisco Desert. Subjectively, prairie dogs were reported to be at an all-time high in this area (W. Bates, pers. commun.), but there is no acreage figure to indicate their actual abundance. White-tailed prairie dogs also occur in Rich County in extreme northeastern Utah within the 50,000 acre Deseret Land and Livestock Property. Prairie dogs on this ranch are apparently protected from shooting and poisoning, but the status of plague is unknown (M. Wolfe, pers. commun.). Wolfe did not provide an acreage estimate for this complex, but reported that a biologist from this ranch, Anis Aoude, considered it stable. Prairie dogs on this ranch were the subject of a behavior study (Beck 1994).

RANGE-WIDE ESTIMATE

There are 563,670 acres of recently (past decade approximately) mapped white-tailed prairie dog colonies (Table 4). **There are numerous other colonies that have not been mapped so an accurate range-wide acreage estimate is not possible.** A recent petition to list the white-tailed prairie dog as threatened estimated 805,000 acres of white-tailed prairie dogs (Center for Native Ecosystems et al. 2002). If the range-wide white-tailed prairie dog acreage is between 600,000 and 800,000 acres, and there is an average of two prairie dogs per acre, then there would be between 1.2 and 1.6 million white-tailed prairie dogs.

Population trends reported for the white-tailed prairie dog complexes varies considerably, but most agency personnel reported overall white-tailed prairie dog populations as stable. Smaller monitored areas within larger colony complexes showed both increasing and decreasing trends in response to plague epizootics making generalized statements about overall white-tailed prairie dog population trends meaningless until more intensive monitoring is completed. Prairie dog populations are capable of increasing and decreasing considerably within a span of a few years. Large acreages for complexes mapped during the 1980s in Wyoming and parts of Colorado, but not subsequently, add to the uncertainty about the overall population size and trend for white-tailed prairie dogs. However, it appears clear that two very large colony complexes of white-tailed prairie dogs remain, one in northeastern Utah/northwestern Colorado and one in Shirley Basin, Wyoming. The only comparable surviving complex for any species of prairie dog is the black-tailed prairie dog complex in northern Mexico.

Sylvatic plague is by far the most significant influence on white-tailed prairie populations. Three prairie dogs surviving a plague epizootic in Utah were sero-positive for plague suggesting that there is genetic potential for plague immunity (W. Stroh, pers. commun.). As yet, there is no evidence that this potential functions to protect remaining prairie dog complexes from recurring epizootics of plague. Poisoning continues to occur on private lands, but poisoning efforts are no longer widely sponsored and organized by government agencies. Recreational shooting appears to be a mortality factor range-wide (except Colorado), but there is no information available to quantify this activity for white-tailed prairie dogs. Available information suggests that prairie dog shooting appears to be a localized activity. Agricultural land conversions were identified as a cause of white-tailed prairie dog declines only in Montana. In other areas, land conversions were primarily done earlier in the 20th century and were restricted to areas where irrigation water was available. Montana is the only state with a significant documented range contraction.

Table 4. Summary of recently mapped prairie dog acreages by species and state. None of the state acreages are considered a complete accounting of prairie dogs.

STATE	WHITE-TAILED PRAIRIE DOGS	GUNNISON'S PRAIRIE DOGS
Montana	120	Out of range
Wyoming	340,000	Out of range
Colorado	125,766*	85,795*
Utah	97,786	3,678
New Mexico	Out of range	None
Arizona	Out of range	106,000
Range-wide Estimate	None	None

*Acres identified as "active" within last three years (Colorado Division of Wildlife 2002).

The large mega-complex of white-tailed prairie dogs in northwestern Colorado and northeastern Utah contrasts with the situation for black-tailed prairie dogs. Most of the large black-tailed prairie dog complexes are long gone. The FWS was unable to find even 10 black-tailed prairie dog complexes exceeding 10,000 acres (Knowles 1998). However, the range-wide black-tailed prairie dog population is much greater than white-tailed prairie dogs (perhaps 10 to 20 times greater) and the population is much more evenly distributed over a far larger area (six times greater). A mega-complex is a series of large prairie dog colonies that are a dominant landscape feature over a large block of land (>100,000 acres). A probable explanation for the loss of all black-tailed prairie dog mega-complexes and the survival of at least two large white-tailed prairie dog mega-complexes is the high density and conspicuous nature of black-tailed prairie dog colonies. Also, the range distribution of black-tailed prairie dogs overlapped significantly with lands considered suitable for dryland agriculture and prime grazing lands.

CURRENT STATUS - GUNNISON'S PRAIRIE DOG

COLORADO

A statewide effort to map white-tailed and Gunnison's prairie dogs is currently underway in Colorado. As noted above, during July and August 2002, field biologists with the Colorado Division of Wildlife, the US Forest Service and the Bureau of Land Management drew polygons of Gunnison's prairie dog colonies known to have been active within the last three years on 1:50,000 scale maps. A total of 85,795 acres of "active" Gunnison's prairie dog colonies in Colorado was delineated in this way (Table 2, Colorado Division of Wildlife 2002). Additional "active" acres were identified in Delta County where the prairie dog species was uncertain (Table 2). In addition to these "active" acres, 194,777 acres were delineated where Gunnison's prairie dogs were known to have been previously present, but where their current presence was unknown (Colorado Division of Wildlife 2002). The 85,795 acres identified as "active" is considered by Colorado Division of Wildlife to be a preliminary minimum estimate of the number of acres occupied by Gunnison's prairie dogs. These polygons will serve as the basis for identifying strata for subsequent range-wide field surveys that will be completed by mid-summer of 2003 (P. Schnurr, pers. commun.).

It is anticipated that the ongoing survey of all three species of prairie dogs in Colorado will reveal that many more acres of all species exist than are currently documented (L. Nelson, pers. commun.). The Gunnison's and white-tailed prairie dog surveys in 2002 and 2003 are being financed by a $125,000 grant from the Colorado Species Conservation Trust Fund.

Previously, the Colorado Department of Agriculture (1990) estimated the statewide prairie dog acreage, but these estimates clearly greatly inflate the acreage at least for some counties. For example the Department of Agriculture's estimate for Gunnison County is 5,800 acres, but there are only about 600 mapped acres in the county (Table 2), plus 220 additional acres where this species may be present (Colorado Division of Wildlife 2002). Fitzgerald (1991) also considered the Department of Agriculture's figures for Gunnison's prairie dogs to be incorrect. The problem with that Department's acreage estimates, is related to a flawed sampling design. The few areas where there was current mapping information on prairie dog abundance, suggest the colonies are small and not numerous. Maps based on data collected in the 1970s and 1980s associated with energy development projects were not specific to species in areas where Gunnison's prairie dogs overlapped with white-tailed prairie dogs.

The Gunnison's prairie dog has been badly impacted by plague in Colorado. Much of the decline in Colorado can be attributed to sylvatic plague, although poisoning was a significant factor, as well, especially in the first half of the 20th century (Clark 1989). The decline of the Gunnison's prairie dog due to plague in Colorado is documented in the literature (Eke and Johnson 1952, Lechleitner et al. 1962, Lechleitner et al. 1968, Fitzgerald and Lechleitner 1974, Rayor 1985, Fitzgerald 1993). In South Park, Colorado there were 913,000 acres in 1941 and there was a 95% decline by 1949 (Ecke and Johnson 1952). Today there are only a few hundred acres in what was once a single giant prairie dog town in South Park. There has been no effort to recover prairie dogs in this area. The absence of monitoring of Gunnison's prairie dog populations in the recent past is alarming in light of the documented decline. The ongoing survey will provide badly needed information on the current status of Gunnison's prairie dogs in Colorado.

UTAH

A total of 3,678 acres of Gunnison's praire dog colonies were surveyed during 2002 in Utah (Utah Division of Wildlife Resources file data). This species is still considered relatively abundant in Utah (W. Bates, pers. commun.). Plague is a factor and populations cycle up and down (W. Bates, pers. commun.). The

BLM provided no useful information on the Gunnison's prairie dog in Utah. There is some recreational shooting of Gunnison's prairie dogs in Utah, but it has recently been protected from shooting during the period of 1 April to 15 June. This protection has not been extended to the white-tailed prairie dog except on the ferret reintroduction area in the northeastern region. There is no license requirement for either species of prairie dog in Utah.

NEW MEXICO

There is no current information on the status of the Gunnison's prairie dog in New Mexico, and the New Mexico Game and Fish Department did not want to make an estimate of the current acreage (G. Schmitt, pers. commun.). A 1984 account of the Gunnison's prairie dog suggests that there were approximately 75,000 acres of prairie dogs at that time. Hubbard and Schmitt (1984) compiled sufficient information to indicate that the decline of the Gunnison's prairie dog in New Mexico due to poisoning was substantial. There are published accounts of plague epizootics in New Mexico (Cully et al. 1997), and the impact of plague in at least some areas appears similar to the South Park situation in Colorado (J. Cully, pers. commun.) In these areas, it appears that prairie dogs may not recover from repeated plague epizootics (J. Cully, pers. commun.). Approximately half of the Gunnison's prairie dog acreage is located on private lands (G. Schmitt, pers. commun.) where they are subjected to periodic control (J. Hansen and D. Heft, pers. commun.). The Gunnison's prairie dog has expanded its range into the Santa Fe area where historically black-tailed prairie dogs occurred (G. Schmitt, pers. commun.), and it is also now present east of the Rio Grande River in the Socorro area (D. Heft, pers. commun.). Although there have been documented declines in northern New Mexico due to plague (Cully 1997) since the 1984 report by Hubbard and Schmitt (1984), the Gunnison's prairie dog population is considered to be stable at least in some areas (J. Hansen and D. Heft, pers. commun.). A survey of Mora and Colfax counties in northeastern New Mexico suggests that Gunnison's prairie dogs occur in very small colonies (Sager 1996). Sager (1996) reported only observing 34 individuals at six sites.

ARIZONA

Approximately 106,000 acres of Gunnison's prairie dog colonies have been mapped in Arizona in recent years (W. Van Pelt, pers. commun.). This is a minimum estimate since there are no reports available from two Indian reservations and only a portion of the Navajo reservation has been mapped (Yazzie 1996). The Gunnison's prairie dog population is considered to be stable in Arizona (W. Van Pelt, pers. commun.), but this assessment was made prior to a major plague epizootic in late summer 2001. Plague has been documented in most areas of the Gunnison's prairie dog range in Arizona except the Aubrey Valley in northwestern Arizona (W. Van Pelt, pers. commun.). The recent plague epizootic has had a substantial impact on prairie dogs in northern Arizona (D. Wagner, pers. commun.). Approximately 14,315 acres of prairie dog colonies were mapped on the Navajo reservation in the mid 1990s (Yazzie 1996). Reexamination of these colonies during late summer 2001 found that most of the colonies were gone or drastically reduced (D. Mekesic, pers. commun.). The mid-1990 mapping effort on the Navajo reservation now has little relevance to the current status of the Gunnison's prairie dog on the reservation (D. Mekesic, pers. commun.).

The plague epizootic was not confined to the reservation and prairie dogs died in the Flagstaff area, as well (D. Wagner, pers. commun.). Examination of about 50 prairie dog colonies in this area during late summer and early fall 2001 showed that most colonies were gone or drastically reduced (D. Wagner, pers. commun.). The general trend of Gunnison's prairie dogs in many areas in Arizona is now considered as declining (D. Wagner, pers. commun.).

However, plague continues to miss the Aubrey Valley prairie dog complex (D. Wagner, pers. commun.) and prairie dogs in this area have been increasing at this site where black-footed ferrets were reintroduced in 1996. In 1992, 17,196 acres of Gunnison's prairie dogs were documented in the 109,000-acre Aubrey Valley area. About 16% of the landscape in this area was occupied by prairie dogs at that time. Another 2,750 acres of prairie dog colonies forms an adjacent complex separated from the main complex by a series of cliffs. During 1997-1999, the total acres of Gunnison's prairie dogs in the Aubrey Valley complex appeared to be stable at 29,653 acres distributed throughout 16 colonies (Winstead et al. 2000). This was a 72% increase in active prairie dog colony acreage (14% increase per year) and they now occupy about 27% of the Aubrey Valley area. This represents Arizona's largest documented prairie dog complex outside of Indian reservations (Belitsky et al. 1994). Van Pelt (pers. commun.) has suggested that prairie dogs in the Aubrey Valley have genetic resistance to plague. Based on burrow densities in 64 transects, there was a mean of 7.4 prairie dogs/hectare (range 5.2-10.7) at the ferret reintroduction site (Winstead et al. 2000).

RANGE-WIDE ESTIMATE

There is no range-wide estimate of Gunnison's prairie dog abundance. There are a total of 195,470 recently mapped acres of this species (Table 4). Arizona, with more than 100,000 acres of Gunnison's prairie dogs, is the only state with a relatively complete mapping effort outside of Indian reservations. Up until late summer 2001, the Gunnison's prairie dog population was considered stable in Arizona. Currently, however, a large plague epizootic is having a major impact on the Gunnison's prairie dog in this state. Regardless, the Aubrey Valley remains unaffected by plague and the Gunnison's prairie dog population continues to increase in this area and may be the largest surviving complex of Gunnison's prairie dogs.

Information available for Colorado suggests that Gunnison's prairie dogs were greatly reduced during the 1900s by plague and poisoning, and this long-term decline may be continuing or, at best, Colorado populations may now be stable at greatly reduced levels. Information obtained in 2002 indicates the presence of more Gunnison's prairie dogs than previously suspected (Colorado Division of Wildlife 2002), but less than 100,000 acres are currently documented in Colorado.

In New Mexico there also appears to have been a large decline caused by plague. In New Mexico, there are published accounts of prairie dog decline due to plague with the general impression that recovery from plague may be very slow or may not occur at all (J. Cully, pers. commun.). Extensive poisoning of New Mexico's prairie dogs during the first half of the 20th century is well documented. Although New Mexico Game and Fish declined to estimate the Gunnison's prairie dog population in their state, they considered the Gunnison's prairie dog population to be stable. A 1984 accounting of prairie dogs in New Mexico suggests there were no remaining large Gunnison's prairie dog complexes.

Only a small portion of the Gunnison's prairie dog range is in Utah. Mapping efforts in 2002 delineated 3,678 acres of active Gunnison's prairie dog towns.

Plague continues to be a major factor influencing Gunnison's prairie dog populations. The loss of the South Park, Colorado mega-complex due to plague and poisoning is well documented in the literature. There are other well-documented epizootics reported for Colorado and New Mexico, and recent unpublished information for Arizona. This species is believed to be more susceptible to plague than the white-tailed prairie dog. However, Cully et al. (1997) documented some plague survivors as being sero-positive for plague.

Based on the lack of current population estimates throughout much of the Gunnison's prairie dog range and the documented threat of plague, there appears to be legitimate concern for conservation of this species. If plague, poisoning, and recreational shooting limits Gunnison's prairie dog abundance to about 0.25% to 0.50% of the landscape within its range distribution (New Mexico 1984 data and current Arizona mapping data), and assuming similar densities for Colorado and Utah, then a range-wide estimate would be between 200,000 and 335,600 acres of Gunnison's prairie dogs. If the average density was about five prairie dogs per acre, the total population would be close to 1.0 to 1.7 million individuals.

ASSOCIATED SPECIES

Collectively, the five prairie dog species occupied a significant part of the landscape on the Great Plains and the Intermountain West. The range distributions of the three widespread species had significant zones of overlap in Montana, Wyoming, Colorado, and New Mexico. Collectively, these three species provided a series of mega-complexes and smaller complexes distributed over a vast landscape. Not surprisingly, there are wildlife species adapted to coexist with prairie dogs. Much of the research on prairie dog associated species has been conducted within the range of the black-tailed prairie dogs. Reports of up to 117 wildlife species associated with prairie dogs (Sharps and Uresk 1991) may over estimate the number of species associated with prairie dogs, but there are a number of species that are benefitted by prairie dogs. These close associates appear to also use white-tailed and Gunnison's prairie dog colonies, as well as black-tailed prairie dog colonies (Campbell and Clark 1981, Clark et al. 1982). Most biologists that I interviewed stated that burrowing owls were found on prairie dog colonies in the areas that they worked. Others reported ferruginous hawks (*Buteo regalis*), mountain plovers (*Charadrius montanus*), golden eagles (*Aquila chrysaetos*), and badgers (*Taxidea taxus*), too. The black-footed ferret was considered extinct in the wild and reintroduction attempts have now been made in the Shirley Basin complex in Wyoming (white-tailed prairie dogs) (R. Luce, pers. commun.), in the white-tailed prairie dog complex in northeastern Utah/ northwestern Colorado (W. Stroh, pers. commun.), and with Gunnison's prairie dogs in Aubrey Valley, Arizona (W. Van Pelt, pers. commun.).

CONSERVATION CONSIDERATIONS

Although there is no range-wide data to quantitatively assess the decline of white-tailed and Gunnison's prairie dogs during the 20th century, there are qualitative indicators of substantial decline. These indicators of decline have been reviewed in this paper. For the white-tailed prairie dog, there is documentation that in the Meeteetse, Wyoming area, that prairie dog occupied acres have declined from an estimated 200,000 acres in 1915 to about 500 acres by 2000. There is also good documentation to show that the white-tailed prairie dog declined substantially in Montana and is now on the verge of extirpation. For the Gunnison's prairie dog, documentation of prairie dog control in New Mexico and a 1980s estimate of prairie dog abundance suggests that the decline of Gunnison's prairie dogs in that state exceeds 90%. The impacts of unregulated prairie dog control are dramatically illustrated by the extirpation of black-tailed prairie dogs from Arizona, and the near extinction of the Utah prairie dog in Utah. The potential for plague to significantly change prairie dog ecology across a broad region has been documented in South Park, Colorado and in the Moreno Valley, New Mexico. Since poisoning and plague appear to be common features throughout the range of white-tailed and Gunnison's prairie dogs, it can be assumed that these impacts have significantly affected prairie dogs elsewhere, although it is not well documented.

This investigation has shown that two mega-complexes of white-tailed prairie dogs still exist and may comprise up to half of the current white-tailed population. Recent monitoring in these two complexes suggests that plague is a significant factor, but because of the immense size of the complexes there is no clear upward or downward trend. The Gunnison's prairie dog population is highly fragmented into complexes of small colonies due to plague and poisoning. The large mega-complexes of Gunnison's prairie dogs are gone. This is a very similar situation found with the black-tailed prairie dog. However, a portion of the black-tailed prairie dog range remains plague-free whereas plague occurs throughout the ranges of all three white-tailed prairie dog species. Both the white-tailed and Gunnison's prairie dogs have considerably smaller range distributions than the black-tailed prairie dog and generally occur in lower densities within their colonies than black-tailed prairie dogs. The white-tailed and Gunnison's prairie dogs probably each have total populations of between 1 and 2 million individuals. This might be compared to the Utah prairie dog population that was taken down to about 3,000 individuals by 1973 through poison and plague (Crocker-Bedford and Spillett 1981), and that currently numbers about 5,000 individuals (Bonzo and Day 2000). This is a species that occupies similar habitats as the white-tailed and Gunnison's prairie dogs and was subjected to similar population impacts. This species has persisted once control efforts were finally tightly regulated, but illegal take is still a significant population impact (Bonzo and Day 2000).

For prairie dogs, large numbers of surviving individuals may provide a misleading impression of a more secure conservation status than actually exists. This is because they are extremely colonial and are not continuously distributed as individuals across a large landscape (e.g., deer mouse (*Peromyscus leucopus*)). Having all members of a local population concentrated in a relatively small area, makes them susceptible to catastrophic events such as plague and poisoning, and when a colony complex is reduced to a few remnant colonies, these colonies still remain vulnerable to catastrophic events. This situation has led to the depletion of nearly all large mega-complexes, which represent the conditions under which prairie dogs and their associated species evolved. Therefore, threats to prairie dogs and associated species are derived from increasing fragmentation, isolation, and reduction in size of colonies. Over time, as catastrophic events eliminate colonies, the likelihood that they will ever be reestablished through natural emigration from the surviving colonies declines. Predicably, this scenario is amplified with associated species because small isolated colonies do not provide adequate habitat to maintain viable populations over the long term.

Plague is obviously the main factor with the Gunnison's and white-tailed prairie dogs, and it is not yet clear what the final outcome will be. Perhaps, if there are plague resistant prairie dogs following plague epizootics, these individuals should be identified and relocated to a captive colony for experiments in developing genetic immunity to plague. If mortality from a plague epizootic could be reduced from 99.9% to 90% through increased genetic immunity, population recovery from plague would be considerably faster. A plague vaccine is being developed for prairie dogs (Rocke et al. 2001). Intramuscular and oral administration elicited a protective response in 100% and 25% of the vaccinates, respectively, as compared to 0% survival in negative controls. Rocke et al. (2001) found an 80% bait acceptance rate in oral administration, and concluded that this was a promising route for prairie dog vaccination. Again, if mortality due to plague could be reduced only slightly to the 80-90% range, population recovery would be considerably faster and would be similar to recovery rates reported following single treatments with zinc phosphide grain bait (3-5 years for full recovery)(Knowles 1987, Apa et al. 1990).

During the interview process, it became apparent that outside of black-footed ferret reintroduction areas in Wyoming, Colorado, and Utah, and an ongoing range-wide efforts in Colorado, there has been little recent effort to monitor prairie dog populations (recent efforts in Arizona are already out of date because of plague). Comments made by agency personnel that prairie dog populations were stable or declining within their area of their jurisdiction, were based on casual observations of prairie dogs while conducting other field work. Many of the BLM biologists interviewed commented that they had been at their positions for 10-26 years. However, other biologists noted that they had been at their job positions for less than a year and were unfamiliar with prairie dogs in their area. I respect the observations of long-term biologists and the honesty of the new biologists. However, this investigation shows that there is a need for better monitoring of prairie dog populations within the ranges of the white-tailed and Gunnison's prairie dogs, and this monitoring effort must be adequately documented such that there is continuity in the process, despite a normal change in personnel over time. The Utah Division of Wildlife Resources has monitored Utah prairie dog populations for nearly three decades and appears to have achieved some level of consistency, despite changes in personnel during this period.

The presence of plague throughout the ranges of the white-tailed and Gunnison's prairie dogs over the past 50 years has clearly demonstrated its ability to cause large reductions in prairie dogs within a few years. A good example of this was a report of stable Gunnison's prairie dog populations in Arizona during June 2001; by November 2001, however, a large plague epizootic was noted with prairie dogs in decline across a large area of northern Arizona. Events such as this emphasize the need for agencies to develop and coordinate a regular prairie dog monitoring effort to track trends and estimate abundance. The current information available to determine the status of white-tailed and Gunnison's prairie dogs is inadequate, and the estimates presented in this report on prairie dog abundance represent educated guesses at best. However, long-term white-tailed prairie dog monitoring in southcentral Montana and in Meeteetse and Shirley Basin, Wyoming, would suggest that plague is a problem and can impact large and small colony complexes. Short-term monitoring in northwestern Colorado and northeastern Utah suggest a similar situation among white-tailed prairie dogs in this area. The documented decline of Gunnison's prairie dogs in South Park, Colorado during the 1950s and 1960s, and in Moreno Valley, New Mexico during the 1980s and 1990s are good indications that plague is a significant long-term problem with this species.

Colorado eliminated black-tailed prairie dog shooting on public lands although shooting for control purposes on private lands remains. The restrictions on shooting for black-tailed prairie dogs do not apply to Gunnison's or white-tailed prairie dogs in Colorado.

Of the two species of prairie dogs considered here, it appears that conservation concerns are greater for Gunnison's prairie dogs. This is because the Gunnison's prairie dog appears more susceptible to plague, and much of its preferred habitat is private land where it is subjected to continuing control efforts. Although impacted by plague, two large white-tailed prairie dog mega-complexes still remain, but the history of the Meeteetse complex clearly illustrates that white-tailed prairie dog complexes potentially can be devastated by plague, too. Both species occur in lower densities than black-tailed prairie dogs and have a much smaller geographic range distribution suggesting that plague epizootics are likely to be more significant to the overall conservation of these species.

It is clear that state and Federal conservation agencies need to make a range-wide effort to develop credible status reports on these two species. The Western Association of Fish and Wildlife Agencies has established a subcommittee to review the status of these two species. The multi-state prairie dog conservation team, headed by Bob Luce with support from the National Fish and Wildlife Foundation, has recently expanded its mandate to include these two species, in addition to black-tailed prairie dogs. Arizona and Montana have included one or both of these species in their management planning for black-tailed prairie dogs. Colorado is undertaking a range-wide survey for all three species of prairie dogs. These are positive indications that agencies responsible for wildlife management within the range of prairie dogs may be taking their responsibilities for these two prairie dog species more seriously than they have in the past.

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Mission Statement of the National Wildlife Federation:

To educate, inspire and assist individuals and organizations of diverse cultures
to conserve wildlife and other natural resources
and to protect the Earth's environment in order to achieve a peaceful, equitable and sustainable future.

Report design by Susan J. Scaggs, Staff Assistant
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Red Desert Estimated Harvest & Hunter Expenditure Information
for Big Game and Sage Grouse Species
2000 and 2001 data

SPECIES	HERD UNIT	HUNT AREA	# HARVESTED		# HUNTERS		$ EXPENDITURES	
			2000	2001	2000	2001	2000	2001
Antelope	Red Desert (#615)	Table Rock (#60)	120	64	118	77	$ 130,200	$ 77,888
		Chain Lakes (#61)	298	162	338	196	323,330	197,154
	Sublette (#40)	Steamboat (#92)	961	358	1,149	433	$ 1,049,195	$ 435,698
Mule Deer	Steamboat (#430)	Steamboat (#131)	290	283	862	638	$ 813,610	$ 622,784
	Chain Lakes ((#650)	Chain Lakes (#98)	41	50	120	116	$ 113,078	$ 118,400
Elk	Steamboat (#426)	Steamboat (#100)	292	311	348	378	$ 1,111,936	$ 961,923
	Shamrock (#843)	Shamrock (#118)	55	45	110	81	$ 209,440	$ 139,185
Subtotals					**3,045**	**2,119**	**$ 3,750,789**	**$2,553,020**
Sage Grouse	Red Desert (#9)	Red Desert (#9)	1,144	581	327	194	$ 147,576	$ 79,597
TOTALS					**3,372**	**2,313**	**$ 3,898,365**	**$2,632,617**

*Data taken from Wyoming Game & Fish Department's 2000, 2001 Annual Report and 2000 & 2001 Harvest Reports ($3.9 million $2.6 million)